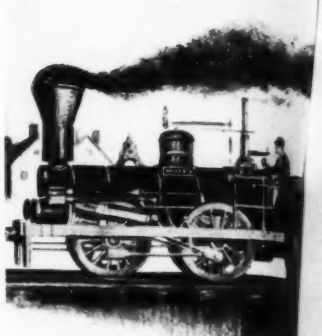
if TRACK IS OUT OF LINE . . . IF OUT OF GAUGE . . . IF ALL IS THE RESULT OF CREEPING RAIL—

then . . .

CAGO • NEW YORK • MONTREAL THE P. & M. CO. LONDON • PARIS • CALCUTTA • SYDNEY

Reliance HY-CROME Spring Washers

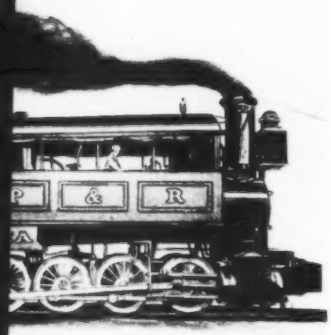
Hy-Pressure HY-CROME
"The Edgemark of Quality."

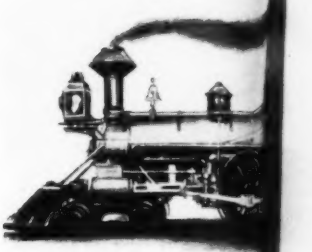


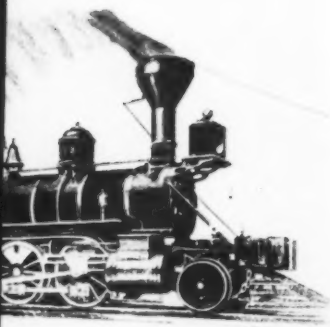
THEY keep BOLTS TIGHT

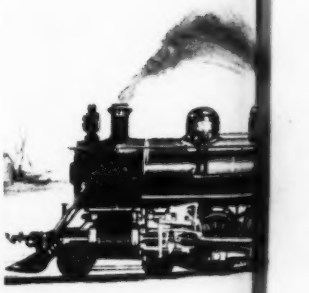
The EXPERIENCED TRACK MAN knows that only proper automatic compensation for wear or looseness, prevents serious damage and acceleration of wear in joint parts and to rail ends.

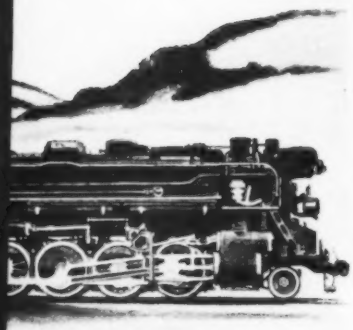
HY-CROME SPRING WASHERS help the track man do a better job more economically—the best device possessing—adequate reactive tension—wide reactive range—non-fatiguing service. Our HY-CROME SPRING WASHER fully meets these service demands, reducing maintenance costs and providing smoother riding track.











A Successful Convention to the Roadmasters Association

TRACK SUPPLY ASSOCIATION
SEPT. 9-12, 1940
MEMBER
HOTEL STEVENS • CHICAGO
ROADMASTERS CONVENTION

A Successful Exhibit to the Track Supply Association

EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON, O.

Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

What length guard rail gives best protection?

MAXIMUM: STRAIGHT GUARDING FACE 10 ft. 6 in.

INTERMEDIATE: STRAIGHT GUARDING FACE 7 ft. 0 in.

MINIMUM: STRAIGHT GUARDING FACE 3 ft. 0 in.

There are two schools of thought on the length of guard rail necessary to protect frog points.

One school feels that the straight portion need only be long enough to guard most of the gap between throat and point, and to overlap the ½-inch point by a minimum of two inches. This requires a minimum straight guarding face of 32 inches for a No. 20 frog, allowing for no inaccuracy in placing or maintaining the guard rail. Lengths for other frogs are shown in the table. A 9-ft. 0-in. Hook-flange guard rail, with its three-foot straight guarding face, will safely and adequately meet these requirements for all frogs up through a No. 20—provided it is accurately placed and properly maintained.

The other school feels that the entire gap must be guarded, from throat to point, and that in addition sufficient overlap of the point must be made to straighten up the truck for its passage past the ½-inch point. For a No. 20 frog, it takes 47½ inches to guard the gap only. Another three feet, for overlap, brings the straight guarding face up to about seven feet. This equals the straight portion of the 13-ft. 0-in. Hook-flange guard rail, which is recommended by Bethlehem for all frogs of No. 10 or smaller angle.

Some engineers believe that even a 7-foot straight guarding face is too short for maximum safety with high-speed movements. For such cases, Bethlehem offers the 16-ft. 6-in. Hook-flange guard rail, with its 10-ft. 6-in. straight portion.

You will find the following table of interest regardless of the school of thought you follow. It shows how the Hook-flange guard rail meets requirements for minimum or maximum protection.

Frog No.		4	5	6	7	8	9	10	11	12	14	15	16	18	20
Gap* throat to ½" point		9.6"	12.0"	14.3"	16.7"	19.1"	21.4"	23.8"	26.2"	28.5"	33.3"	35.7"	38.0"	42.8"	47.5"
Minimum Straight Guarding Face	Ahead	12"	12"	14"	14"	14"	14"	14"	16"	18"	18"	24"	26"	30"	30"
	Back	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"

*Gap figured as $\frac{f}{\sin a} + \frac{1}{2} N$; a = frog angle, N = frog number, f = 1⅜" flangeway

HOOK-FLANGE GUARD RAIL

6'0" Guard Rail	Essentially a switch point guard rail but may be used with No. 4 and No. 5 turnouts. 3' 0" straight guarding face.
9'0" Guard Rail	3' 0" straight guarding face meets minimum requirements if properly placed 4½" back of ½-inch point and 31½" ahead.
13'0" Guard Rail	7' 0" straight guarding face; recommended for No. 10 and smaller-angle frogs, placed 41¾" back of ½-inch point and 42¼" ahead when used with No. 10.
16'6" Guard Rail	Maximum protection on small-angle frogs. 10' 6" straight guarding face, ample for full protection ahead and back of point.

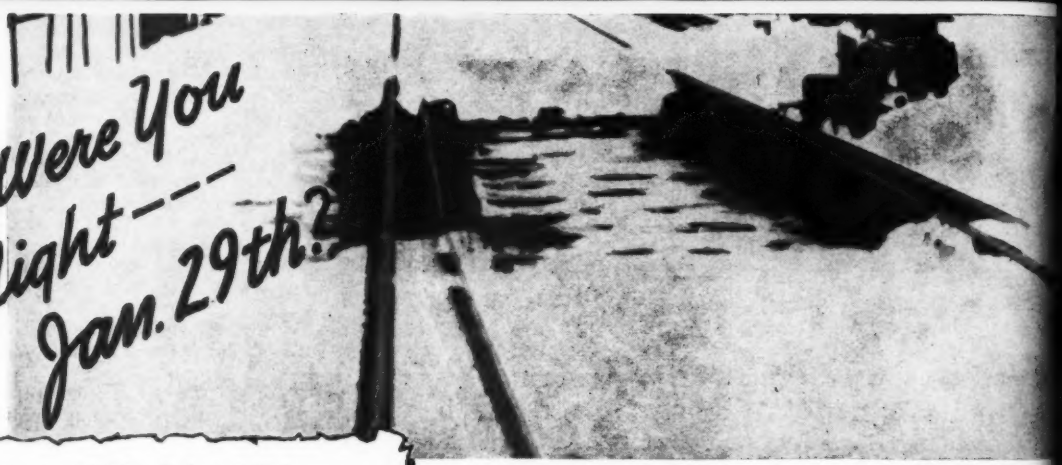
BETHLEHEM STEEL COMPANY

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Illinois. Subscription price: United States and Possessions, and Canada, $2.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

Conquer Snow

WITH ELECTRIC HEAT

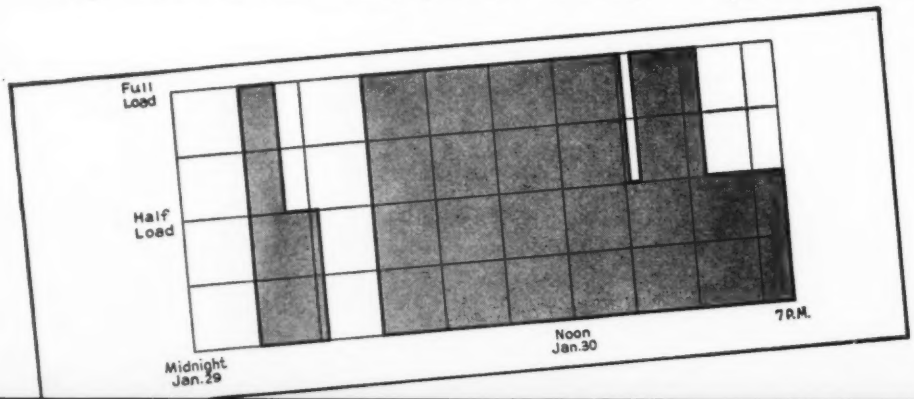
—the Easy, Inexpensive Way



Where Were You that Night— Jan. 29th?

The storm began at midnight. It lasted 19 hours—piled up 14.6 inches of snow. Temperature stayed between 23 and 30 F. Wind velocity—from 15 to 30 mph.

G-E Electric Switch Heaters were on the job—ready to go into action on a moment's notice. They were on 84 switch points, involving switches of all types. The total power consumption was 4000 kw-hr. At one cent per kilowatt-hour, that's $40. Here's the load curve.



No Delays and No Attendance—It's as simple as that. You may have more or fewer switches in your area. In any event, you will see by comparison that the cost of keeping your switches clear would be surprisingly lower with G-E electric snow melters.

General Electric Co.
Schenectady, N. Y.

GENERAL ELECTRIC

96-608

CARS THAT HE NEVER RIDES

Help Him Arrive On Time

An important reason why American train schedules are so consistently maintained is the high standard of service of the maintenance-of-way men who keep signals, switches and road-bed at top notch efficiency. To meet the specialized requirements of these men, Fairmont has engineered the world's most complete line of railway motor cars. The diversity of models has been achieved while still retaining Fairmont's policy of keeping all major parts interchangeable and thereby minimizing the railroad's stocks of repair parts. There is a Fairmont car for every type of hauling job on your road. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

Fairmont

RAILWAY MOTOR CARS

Performance ON THE JOB COUNTS

FAIRMONT M19 SERIES E. Seats 4, is easily handled by 1. Rear lift 95 lbs. 5 to 8 H.P. Fairmont Hy-Load roller-bearing engine.

FAIRMONT M9 SERIES C, 1 to 2 man inspection car

FAIRMONT 59 SERIES C car in signal maintenance work

FAIRMONT A6 SERIES C, 85 H.P. engine, for heaviest extra gang work

FAIRMONT M19 SERIES D in track supervisor's service

FAIRMONT M14 SERIES D for all light section service

A New and Improved 4-Tool Air Outfit for "Out-of-Face" or "Spot-Tamping"

Saves Time— Effort — Money

The I-R Model D-60 Air Compressor is an ideal, light-weight machine with ample capacity for operating four MT-3 low-air consumption tie tampers or various other combinations of air tools anywhere on the line. It is a two-stage unit delivering air at 100 lbs. discharge pressure.

A small gang of men can transport this machine to the spot required without any fuss or bother, unload it and begin work in short order.

For section work the Model D-60 4-tool Tie Tamper Compressor fills the bill to perfection. It is also used to great advantage in operating spike drivers, rail drills, wrenches, paint sprays, riveters and other air tools—a money saver all around.

955-11

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Survey on wind damage shows

the best records

have been made

by pitch and gravel roofs

Damage to roofs by wind is often a serious problem. Some of the wind damage is done by suction. Some is done by wind getting under exposed laps of roofing and ripping off large sections. What are the records on this? Here is the latest:

A survey was made by a company interested in roofing problems. Records were kept of about 7,500 roofs over a five-year period ending last fall.

Wind damage to roofs without gravel or slag surfaces was more than twice as frequent as to coal tar pitch roofs . . . and the damage was more than six times as much.

A tar roof has 400 pounds of gravel or 300 pounds of slag every 100 sq. ft. That alone is considerable protection against wind damage. Laps aren't exposed; the whole roof is tightly sealed by the heavy top pouring of coal tar pitch.

When you realize that the pitch and gravel roof not only has greater resistance to wind damage, but also greater resistance to sun damage, to water damage, to hail damage, to fire damage . . . you know why it is the coal tar pitch and gravel roofs that have made the fine old records for long life.

When you hear of a built-up roof that has lasted 30 or 40 years, you usually find that it is coal tar pitch. Nothing has happened in the roofing business to indicate that any other type of built-up roofing can equal those old records of the tar roofs.

For your own sake, specify Koppers Coal Tar Pitch Roofing.

OTHER KOPPERS PRODUCTS:

Tarmac Road Tars for paving drives, parking areas, walks, etc. . . . Bituminous-base Paints . . . Pressure-treated Piling and other timber products . . . Coal . . . Coke . . . American Hammered Piston Rings . . . Wood Preserving Oils

KOPPERS COAL TAR ROOFING—KOPPERS COAL TAR WATERPROOFING

KOPPERS COMPANY · TAR AND CHEMICAL DIVISION

Pittsburgh, Pa. Kearny, N. J. Providence, R. I. Chicago, Ill. Woodward, Ala.

Be **KOPPERS** products

Insist on PRESSURE PENETRATION FOR DEPENDABLE PROTECTION

Permanence can be added to all the other structural advantages of wood *only* by proper pressure treatment meeting specification standards. Countless attempts to use "short-cut" treatments have invariably ended in disappointment and loss. Use of timber with less than standard penetration of preservative brings a definite danger of early failure. Experience indicates that only pressure treatment can give adequate penetration.

For your own protection, specify *pressure treatment with recognized preservatives,* and insist on the *penetrations adopted as standard by the American Wood-Preservers Association.*

Send for the data sheet, "How to Measure the Quality of Pressure Treatment," which lists the minimum penetrations required for maximum economical service.

Ask for Literature on any of these Products

OTHER USES FOR PRESSURE-TREATED TIMBER: Tipples . . . Piling . . . Guard Rails . . . Fences . . . Poles . . . Buildings, Bins, Sheds . . . Piers . . . Docks, Wharves . . . Platforms . . . Flooring . . . Tanks, Sumps, Vats . . . Crossing Plank . . . Barge Sides and Bottoms . . . Cable Ways . . . Conduit . . . Culverts . . . Flumes . . . Trench Lining and Covers . . . Conveyor Decking and Supports.

OTHER KOPPERS PRODUCTS FOR THE RAILWAY FIELD: Coal . . . Coke . . . Coal Cleaning and Handling Systems . . . General Engineering and Construction . . . Roofing . . . Waterproofing . . . Cylinder Packing . . . American Hammered Piston Rings . . . D-H-S Bronze . . . Tar Base Paints . . . Weed Killers Car Floats, Ferries . . . Tarmac Paving . . . Disinfectants, Insecticides.

$20,000,000 YEARLY SAVINGS ARE POSSIBLE according to the editor of a railroad magazine, through the universal use of pressure treated wood in the 13,000,000 lineal feet of timber in bridges now serving on American Railroads. Pressure-creosoted timbers need no paint, resist fumes, exposure, decay and insect attack, and are more resistive to abrasion and mechanical wear.

THE WOOD PRESERVING CORPORATION
PITTSBURGH, PA.

a KOPPERS subsidiary

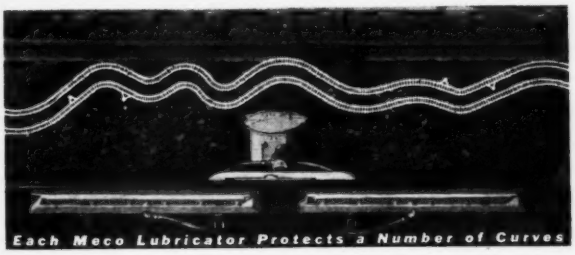
MAKE YOUR TRACK LIKE THE "ONE-HOSS SHAY"

The famed "One Hoss Shay" had no weak spots, each individual part was designed to last exactly as long as every other part. Hence, its fabulously long life before replacement was necessary.

Likewise the complete replacement of track can be postponed only by protecting its weak points.

CURVE RAIL LIFE can be prolonged 3 or 4 times —curve rails made to last as long as tangent rails—with

MECO CURVE LUBRICATORS



Each Meco Lubricator Protects a Number of Curves

(Long Range Lubrication gives ample protection to the extreme end curves of a long curve territory)

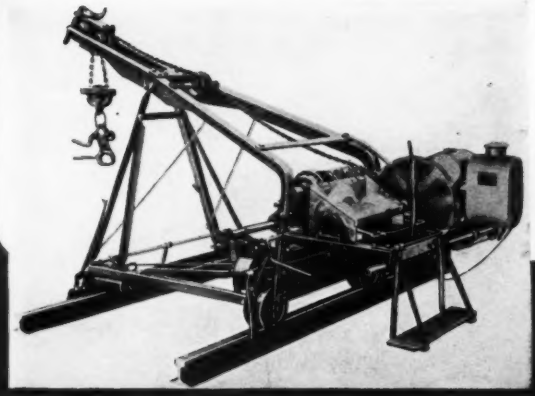
OVER 3700 IN USE

SWITCH RAIL LIFE can be extended 8 or 10 times by protecting switch points with

MACK REVERSIBLE SWITCH POINT PROTECTORS

(Makes switch point last as long as the heel)

MAKE RAIL HANDLING DOLLARS GO 3 TO 4 TIMES FARTHER



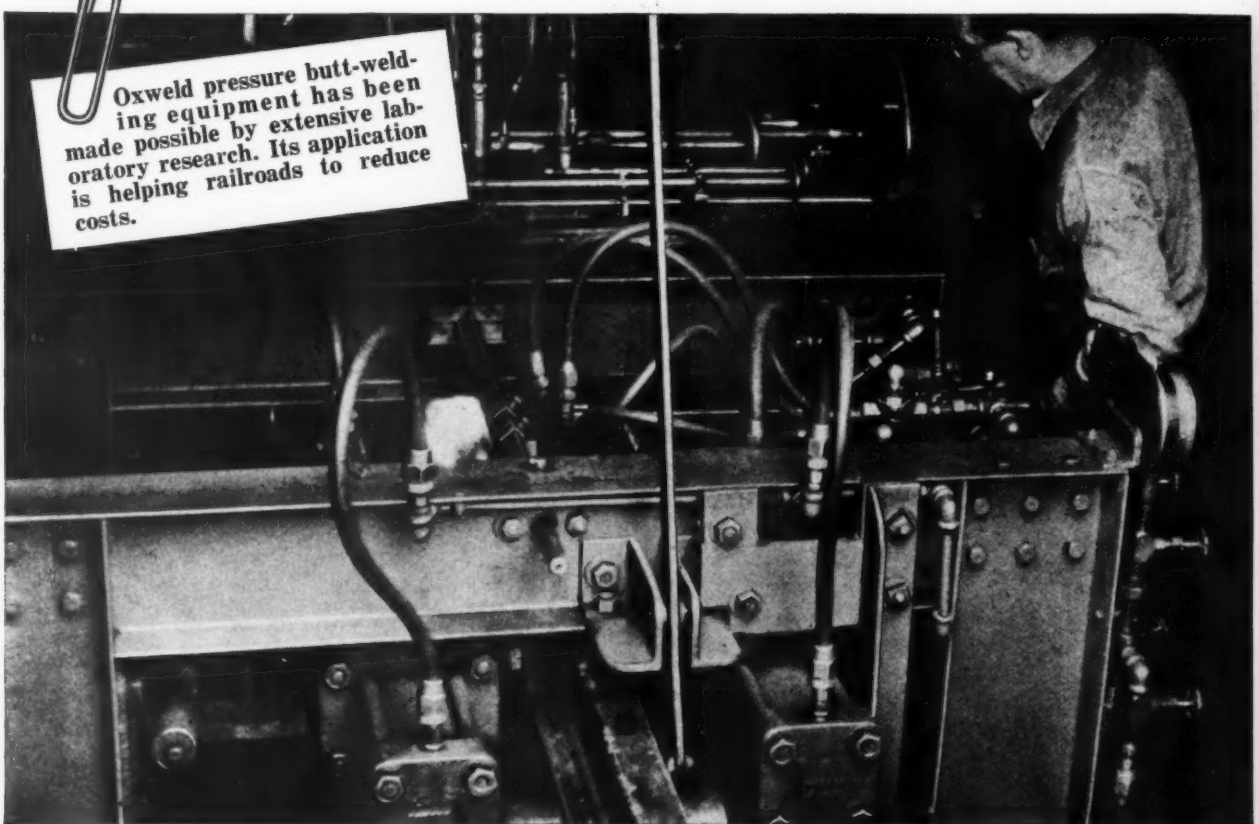
THE POWER RAIL LAYER costs less to buy—less to operate—requires no train orders—no expensive power-propulsion equipment.

Are you Overlooking

MAINTENANCE EQUIPMENT COMPANY

RAILWAY EXCHANGE BUILDING CHICAGO, ILLINOIS

Maintenance Costs
with These and Other Proved

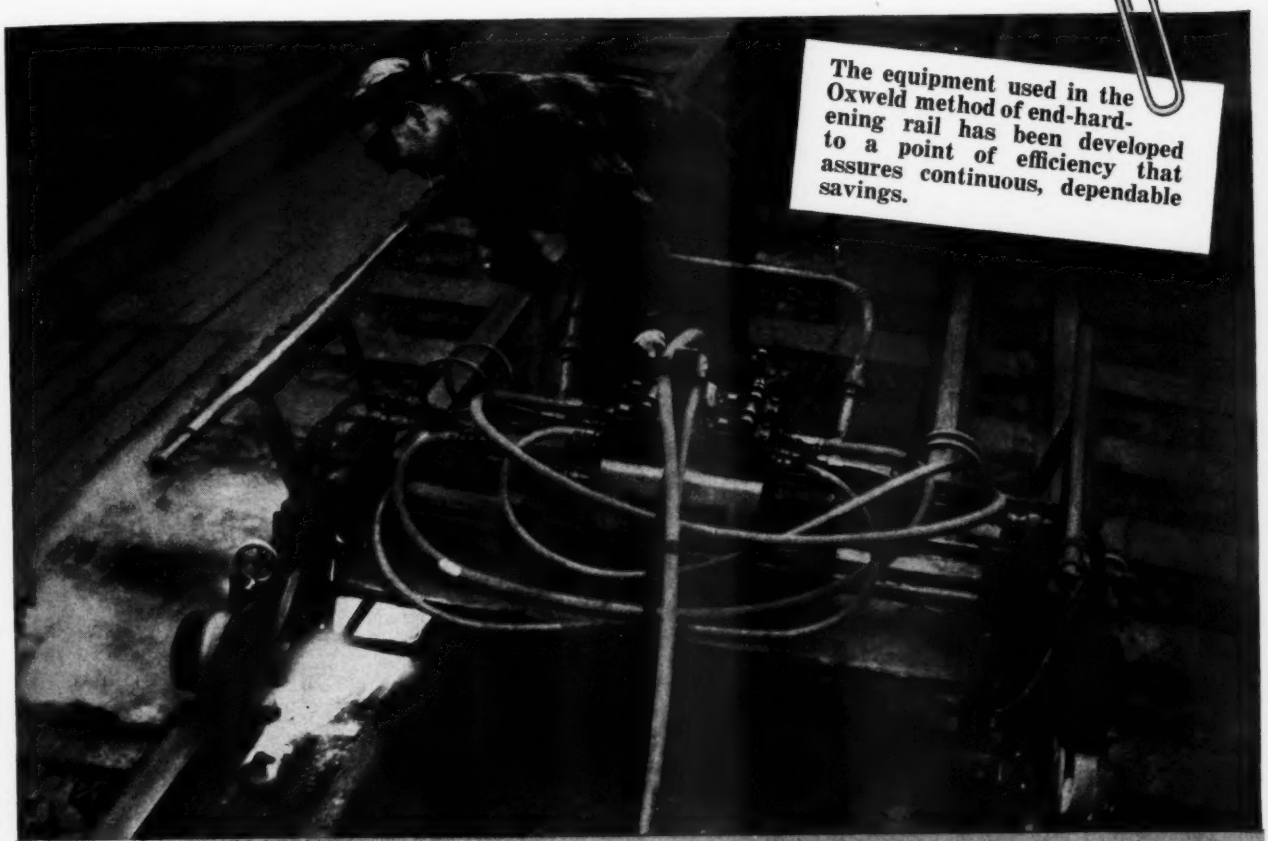

Oxweld pressure butt-welding equipment has been made possible by extensive laboratory research. Its application is helping railroads to reduce costs.

CONTINUOUS WELDED RAIL—The Oxweld pressure butt-welding method is being widely used. Butt-welded rail installed on open deck bridges greatly reduces impact. Used in road crossings and station platforms, it avoids tearing up pavement to repair rail joints. It completely eliminates joint maintenance in tunnels and other installations.

SINCE 1912—THE COMPLETE OXY-ACETYLENE

can be Reduced

OXWELD DEVELOPMENTS



The equipment used in the Oxweld method of end-hardening rail has been developed to a point of efficiency that assures continuous, dependable savings.

END-HARDENED RAIL—Laying of new rail with hardened ends is now standard practice for most railroads. The Oxweld method of end-hardening rail produces long-lasting results. A uniform, batter-resistant hardness is obtained in track at low cost. This method effects substantial reductions in joint maintenance.

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation
Carbide and Carbon Building Chicago and New York

OXWELD

The word "Oxweld" is a registered trade-mark of a Unit of Union Carbide and Carbon Corporation

SERVICE FOR AMERICAN RAILROADS

SOLVE NEXT YEAR'S *Weed Problems* THIS YEAR

While this year's weed problems are fresh in mind, it is a good time to prepare to solve *next year's* problems by including WOOLERY WEED BURNERS in your 1941 budget.

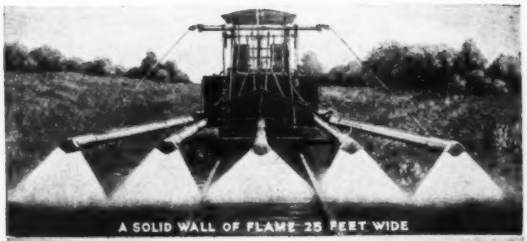
Whether the weeds are in main line, branch line or yard tracks —or about buildings, crossings, etc.,—there's a WOOLERY WEED BURNER for every job . . . from the OCTOPUS models with five, three or two burners—to the JUNIOR model, which is easily handled by one man for OFF-TRACK work. The JUNIOR will be equally efficient in melting snow and ice from switches, culverts, drainage pipes, etc., this winter.

TRACK SUPPLY ASSOCIATION SEPT. 9-12, 1940 EXHIBITOR HOTEL STEVENS · CHICAGO ROADMASTERS CONVENTION

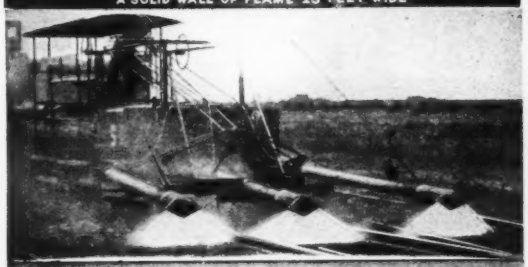
Write for information that will help you select the models you need — then, INCLUDE THEM IN YOUR BUDGET.

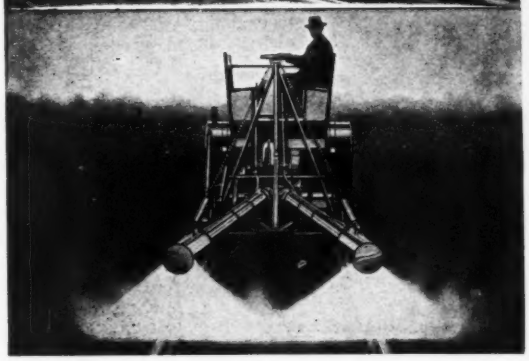
WOOLERY MACHINE COMPANY

MINNEAPOLIS · · MINNESOTA



A SOLID WALL OF FLAME 25 FEET WIDE





The Woolery machine cuts the tie in three pieces which are easily LIFTED (not dug) out.

"OVER THE DAM"

This year's tie renewal problems are largely "over the dam" . . . BUT, while they are still fresh in mind, plan now to reduce *avoidable* trouble and expense NEXT YEAR.

You can cut costs 30% or more—do the work easier—complete the program weeks, or even months, ahead of schedule . . . by putting WOOLERY TIE CUTTERS in your 1941 budget and on the job next spring.

Retamping is practically eliminated—the compacted bed of the old tie is not disturbed—the track surface is not affected. The machine—light in weight—can be removed from the track by the operator in 10 seconds—it is compact and rides easily on the side of a motor car to point of use.

In the renewal of 900,000 ties last year with WOOLERY TIE CUTTERS, one large road saved more than $100,000.

PUT THEM IN YOUR 1941 BUDGET AND START THE SEASON THE MODERN WAY.

TRACK SUPPLY ASSOCIATION SEPT. 9-12, 1940 EXHIBITOR HOTEL STEVENS · CHICAGO ROADMASTERS CONVENTION

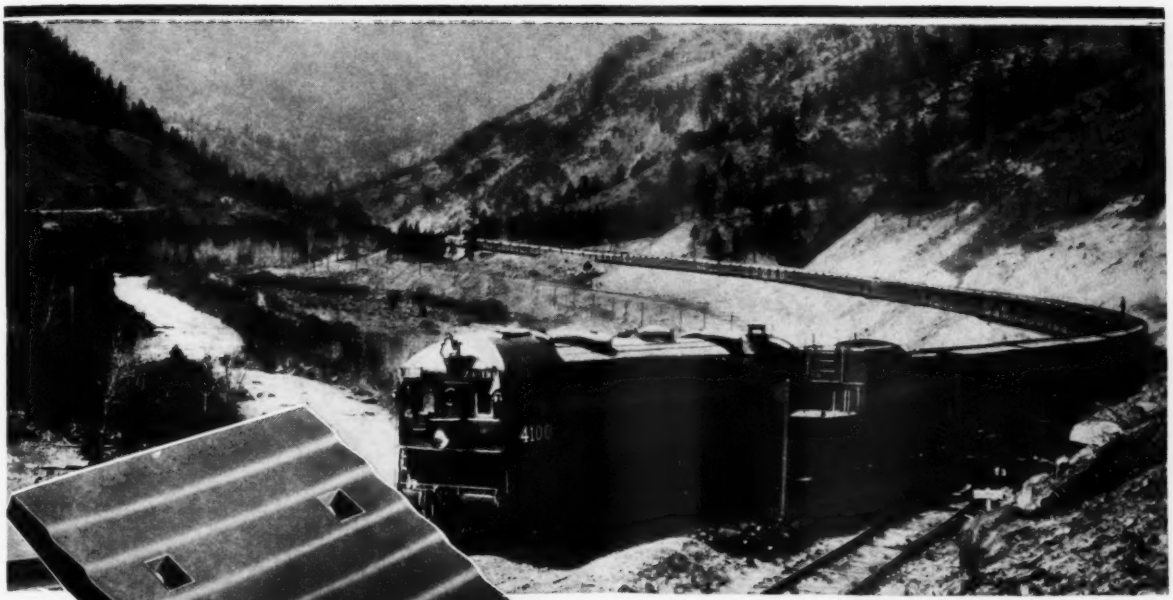
Send for 12-Page Booklet.

WOOLERY MACHINE CO.

MINNEAPOLIS MINNESOTA

Pioneer Manufacturers of
RAILWAY MAINTENANCE EQUIPMENT

TIE CUTTERS • SWITCH HEATERS • MOTOR CARS • RAILWAY WEED BURNERS
BOLT TIGHTENERS



TRACK SUPPLY ASSOCIATION
SEPT. 9-12, 1940
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ROADMASTERS CONVENTION

SAFER STRONGER TRACK AT REDUCED COST

NO matter what you have been using to hold track to gauge, there is nothing that equals the Lundie Tie Plate for this all important duty. Scientifically designed with a corrugated step bottom, Lundie Tie Plates distribute the wheel loads evenly and without injury to the fibres of the wood ties . . . Provide a positive bearing that prevents spreading of track and cants the rails to the proper inclination so that wheels track properly. Lundie Tie Plates are furnished either single or double shoulder and comply with A.R.E.A. specifications and dimensions.

THE LUNDIE ENGINEERING CORPORATION

Tie Plates—Spring Rail Clips—Safety Tongs for Handling Track Material—Aladdin Rail and Flange Lubricator

19 West 50th St., New York **59 E. Van Buren St., Chicago**

LUNDIE TIE PLATE

LATERAL

Center-Overfill

on

HEADFREE

JOINTS

at

NO EXTRA COST

CENTER-EASEMENT ON EITHER
HEADFREE OR HEAD CONTACT JOINTS

INCREASED LIFE due to:
More accurate fit at center.
Greater depth of material at point of maximum wear.
Sustained tightness of Joint.

APPLICABLE TO BOTH
FOUR AND SIX HOLE JOINTS

THE RAIL JOINT COMPANY INC.

50 CHURCH STREET NEW YORK, N. Y.

A SECURE TRACK

is Essential to High Speed Modern Traffic

For Double Shoulder Tie Plates Only

For Both Double and Single Shoulder Tie Plates

Elastic RAIL SPIKES

Less Maintenance
Longer Life of Ties
Quiet Smooth Riding Track

ELASTIC RAIL SPIKE CORP.

Affiliate of Bernuth, Lembcke Co., Inc.

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THE ELASTIC RAIL SPIKE
ONE PIECE EASILY APPLIED

FAIRBANKS-MORSE
Sheffield
INSPECTION CARS
FOR ONE TO FOUR MEN
Sheffield "52" MOTOR CAR
Eclipse
INSPECTION CARS
Important
TO MAINTENANCE MEN
Before completing your maintenance program for 1941, be sure to have a complete file of Fairbanks-Morse descriptive bulletins. The complete set is yours—entirely without obligation. Write for them today. Fairbanks, Morse & Co., Department 88, 600 South Michigan Avenue, Chicago, Illinois.
"First on the Rails...Still First"
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FAIRBANKS SCALES
RAILROAD EQUIPMENT
WATER SYSTEMS
WASHERS-IRONERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

WITH SPRING WASHERS
It's Reactive Power That Counts

. . . and The Hubbard SUPER-SERVICE Gives Most For the Money

Hubbard SUPER-SERVICE Alloy Spring Washers deliver 121 per cent more reactive protection than spring washers to A. R. E. A. Specifications. You get this extra rail and joint saving protection for a fractional increase in cost per washer but at a lower cost per pound of reaction.

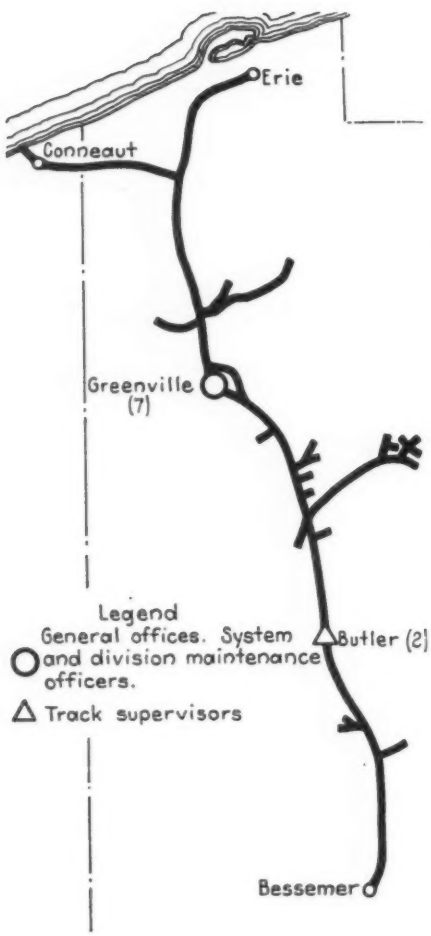
Exhaustive tests have proved that joints bolted with Hubbard SUPER-SERVICE Alloy Spring Washers were not solid or frozen with a bolt tension of 30,000 lbs. Hubbard's SUPER-SERVICE do not go flat at 60,000 lbs. proving that their high reactive power is still working—still effective. As a result of this continuous cushioning protection—wear between rail and joint bars is reduced—rail batter is minimized to the extent that rail and joint bar wear is reduced 80 per cent.

Convince yourself with a trial application on your high speed main line track—crossings—frogs and switches. We will be glad to send a personal representative upon request.

Hubbard and Company
TOOL DEPARTMENT
CHICAGO • PITTSBURGH • NEW YORK

TO RAILWAY SUPPLY MANUFACTURERS

"After the War Orders"



Railway Engineering and Maintenance Goes Every Month to 9 Supervisory Officers on the Bessemer & Lake Erie at the **System and Division Headquarters and at 1 Other Supervisory Headquarters.** This Magazine Also Goes to 52 Subordinate Officers Who Are in Training for Promotion to Supervisory Positions on This Railway.

"Boss, you've certainly got a long head on you," said the star railway salesman to his sales manager.

"What're you driving at now, Bill?" he replied.

"It's this, Boss. I met the chief in the hall today and he told me that you fought him to a standstill on his suggestion that we trim our railway sales expenses now that we've landed that big order from the government."

"Was I right?"

"I'll say you were—a thousand times."

"Why do you think so?"

"I'm contacting these railway men all the time and I know how easy it is for them to forget a company that doesn't keep in touch with them all the time. That's the reason I took that order away from the 'B' Company last month."

"That's the way I figure it. We're going to be in business long after this war is over—and we'll need these railway orders then."

"That's right, Boss. It's a lot easier to hold business than to get it back. By the way, you're going to keep up our advertising in Railway Engineering and Maintenance too, aren't you? You know that's my first assistant, keeping our product before my customers between calls and reaching a lot of men I can't get time to call on."

"I certainly am, Bill. I regard advertising as an essential part of every sales program of mine."

"You're right again, Boss. That magazine reaches ALL our people. It goes from top to bottom in the maintenance of way department. Why, when I was on the Bessemer & Lake Erie Railroad last week, I found there were 61 subscribers, and probably twice that number of readers, on this one railway of only 224 miles."

"That's certainly complete coverage."

"That magazine's got IT, Boss. That's the reason it helps me so much, for I find it everywhere I go."

"I'm glad to hear that, Bill. We're GOING to keep this campaign running as insurance against the day when war orders are no more."

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

A CARDINAL PRINCIPLE

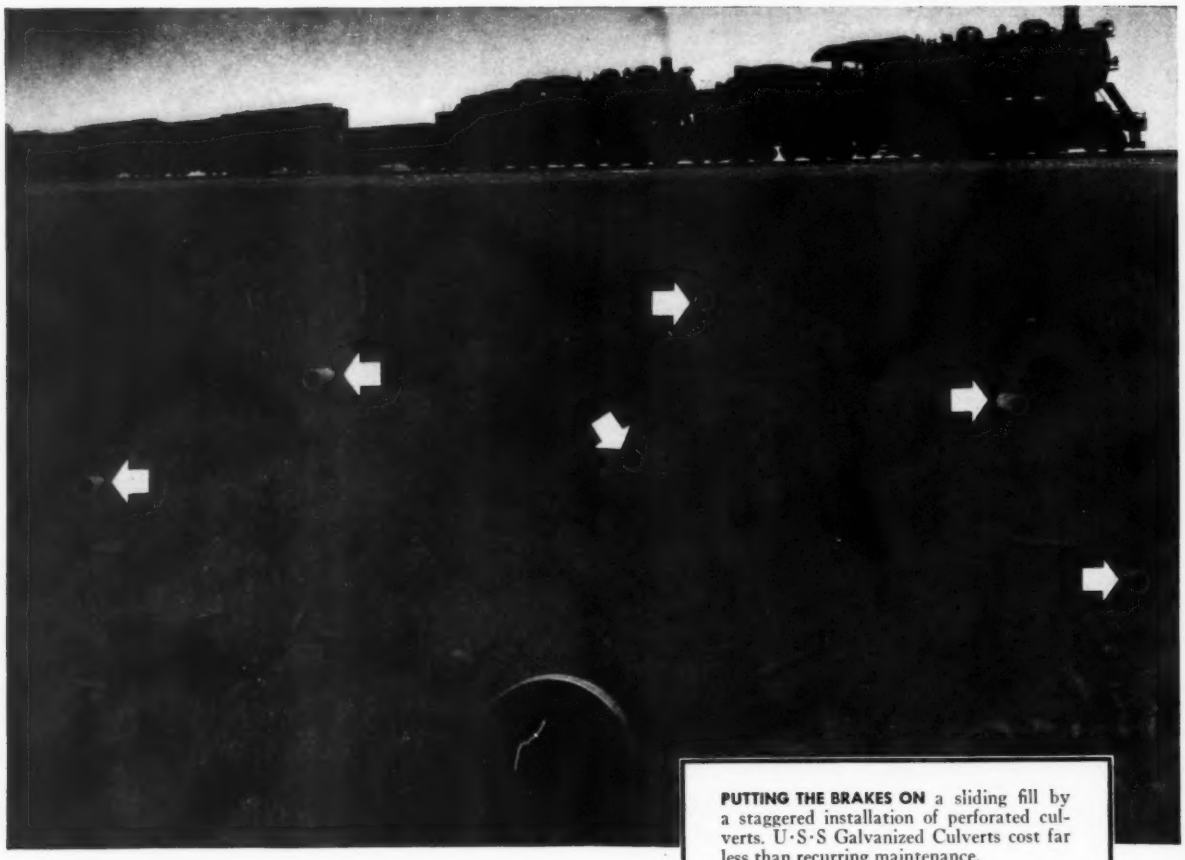
No spring washer for track bolts should go flat before reaching a practicable and workable bolt tension. Most spring washers do not meet this requirement. The Verona *Fixed Tension* SPRING not only meets this requirement but, in addition, provides means of arriving at equal tension in ALL bolts.

SINCE 1873

WOODINGS-VERONA
TOOL WORKS VERONA, PA.

SINCE 1873

Curing a Soft Track and a Slide with **PERFORATED CULVERTS**



PUTTING THE BRAKES ON a sliding fill by a staggered installation of perforated culverts. U·S·S Galvanized Culverts cost far less than recurring maintenance.

THIS section of roadbed was a constant source of trouble. Hundreds of dollars had been poured into repairs but the slide still continued. Finally, perforated galvanized culverts were installed at various points in the bank and the excess water was drained off. The fill dried out and no more trouble was encountered.

Perforated galvanized culverts solve many difficult drainage problems. Wet hillsides above the track, impounded water in the subgrade, water pockets and slides can easily be cured at low cost with a properly designed drainage system.

U·S·S Perforated Galvanized Culverts are ruggedly built to withstand the pounding of heavy traffic and the strain of shifting soil. They can be obtained in either U·S·S galvanized steel, pure iron or rust resisting copper steel.

Write in for more information, prices and the names of U·S·S Culvert Manufacturers operating along your right-of-way.

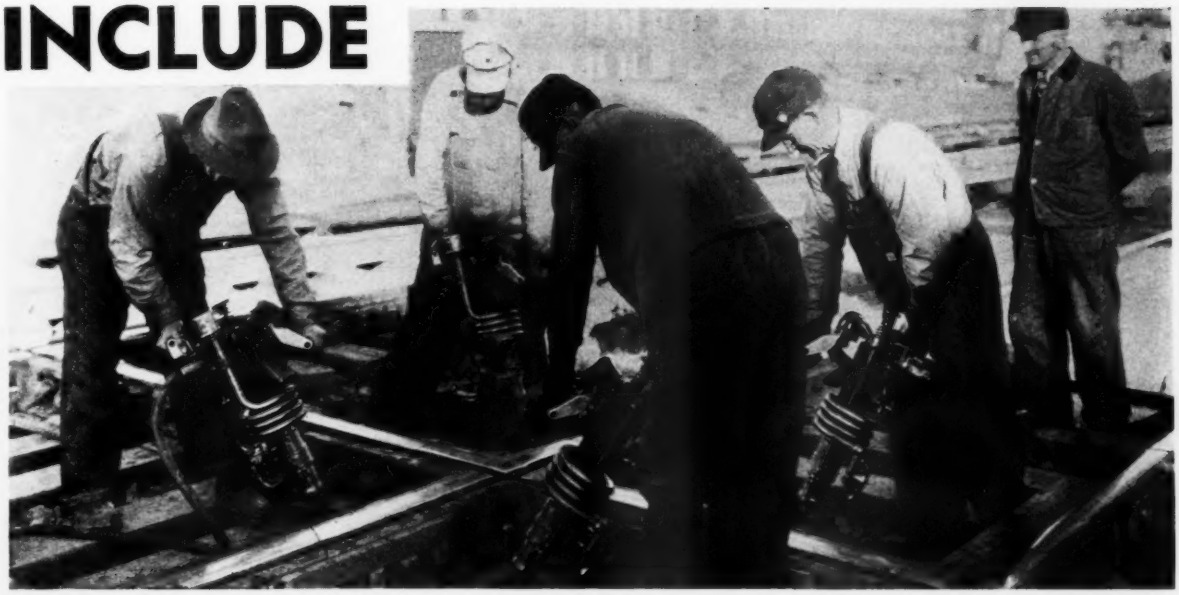
U·S·S GALVANIZED CULVERT SHEETS

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
Scully Steel Products Company, Chicago, *Warehouse Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

In Your 1941 Budget

INCLUDE



BARCO

UNIT TYTAMPERS

Lower Initial Capital Expense for Equipment.

Lower Operating Cost.

All Year Around Service in Gangs or in Individual Units.

Entirely Self-Contained—Carried by One Man—No Auxiliary Equipment Required.

BARCO provides the Most Flexible, Convenient and Efficient Method of Maintaining Thoroughly Tamped Tracks, as Evidenced by Their Use on 64 Railroads.

BARCO

Type K-1 Light Weight Tytamper for all types of ballast and general tamping.

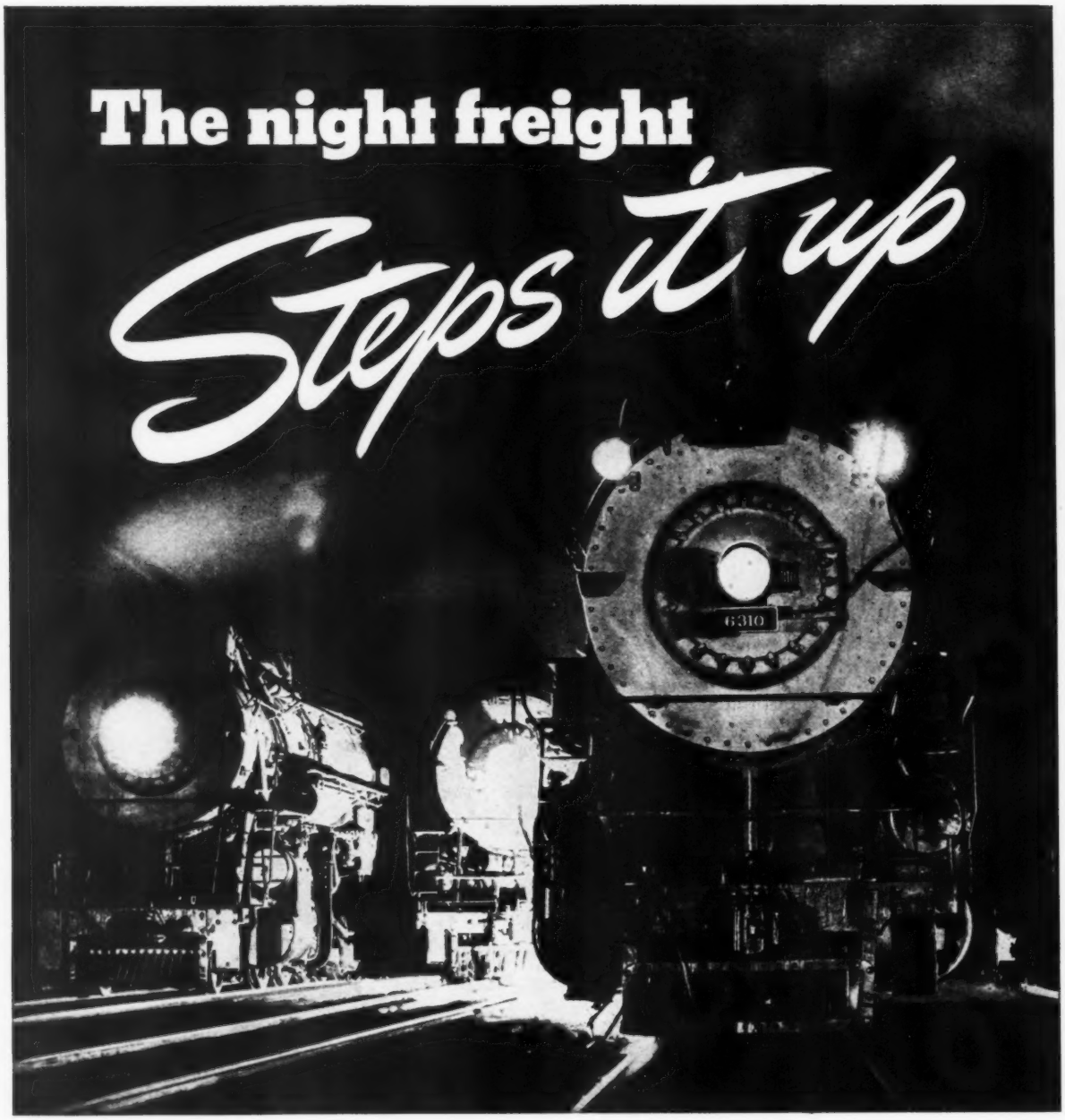
TRACK SUPPLY ASSOCIATION
SEPT. 9-12, 1940
EXHIBITOR
HOTEL STEVENS - CHICAGO
ROADMASTERS CONVENTION

SPACE 70

BARCO MANUFACTURING COMPANY
1805 W. Winnemac Ave. Chicago, Illinois

In Canada
THE HOLDEN COMPANY, LTD.
Montreal — Moncton — Toronto — Winnipeg — Vancouver

The night freight *Steps it up*



Now it's the overnight fast freight service that's adding to the work of track fastenings. Letting 'em roll at 60 means plenty more for the rail joints to stand.

The strength and stamina of Bethlehem Heat-treated Bolts and Hot-forged Nuts fit them for the hardest rail-joint service. They hold the rails to rigid, accurate alignment. The rail joint assembly is held tight, end batter and low joints are kept at a minimum, and maintenance costs are materially reduced.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

After Eleven Years Of Faithful Service

• Same Machine • Same Operator • Same Division

The upper picture shows the first Power Jack placed in service with a ballasting gang on the Milwaukee Road. Because of its performance, seventeen such machines are now serving this system.

Paid for Many Times Out Of Savings

The performance of this Power Jack is typical of that given by Nordberg machines used for maintenance work. Considering the hard usage to which such machinery is put, the fact that after eleven years of service the early jacks are still on the job, proves they can take it year after year.

Working on gravel ballast, this eleven year old jack raised from 9,000 to 10,000 feet of track per day, or about one lift a minute. It has paid for itself many times out of the saving as compared with lifting track by hand methods. Then there is that additional saving in speeding up the entire job because of faster raising and greater accuracy of lift. Track is not thrown out of line, re-raising is unnecessary and, since there is no slipping or kicking out of jacks, the whole ballasting gang moves forward faster and the cost of the job is lessened. Any maintenance tool that will pay for itself as quickly as the Power Jack is always a good investment and one which will continue to pay returns after long years of service.

OTHER NORDBERG TOOLS FOR MAINTENANCE WORK

ADZING MACHINE
SPIKE PULLER
TRACK WRENCH
UTILITY GRINDER
SURFACE GRINDER
PRECISION GRINDER
POWER JACK
RAIL DRILL
TRACK SHIFTER

NORDBERG MFG. CO. MILWAUKEE WISCONSIN

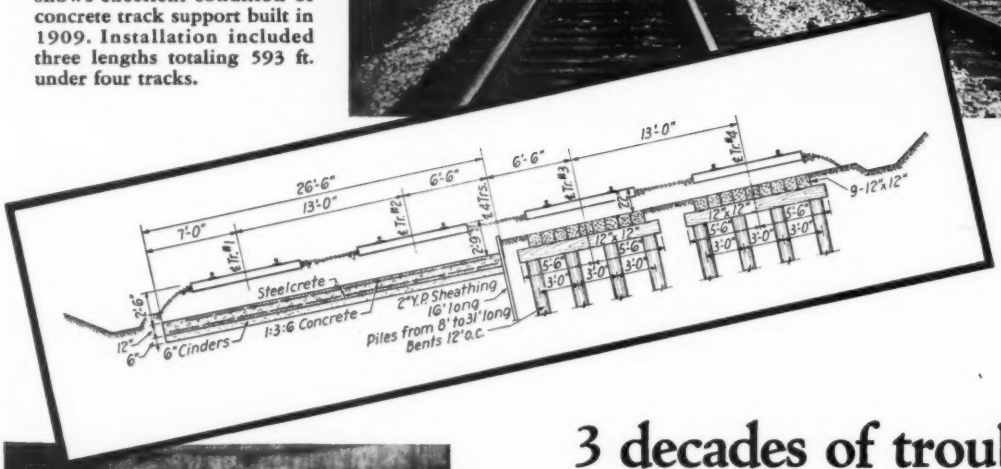
Export Representative—WONHAM Inc.—44 Whitehall St., New York

1912

Recent photo at right shows track at Staatsburg, N. Y., where sections of concrete subballast slab 2722 ft. and 353 ft. long were placed under two tracks in 1912. Inspection in 1940 showed them to be O.K. See cross-section below.

1909

(See below) Photograph taken in 1936 at Poughkeepsie, N. Y., shows excellent condition of concrete track support built in 1909. Installation included three lengths totaling 593 ft. under four tracks.



3 decades of trouble-free service prove the economy of **CONCRETE** supported track

Thirty-one years ago at Poughkeepsie, twenty-eight years ago at Staatsburg, the New York Central placed several sections of subballast concrete slabs.

And now look at the record! On these trouble-spots where the underlying material was either soft blue clay mixed with sand, or water-bearing quicksand, the concrete slabs have resisted the battering of heavy main line traffic. The track has given excellent service and remained in good shape with only ordinary maintenance.

With heavy traffic resulting from vastly increased industrial activity, bad stretches of track can seriously handicap railroads during the next two or three years. Right now is a good time to install needed *Concrete Track Support.* It bridges weak subgrades by absorbing and spreading loads. It provides practically uniform rail support at all seasons and over all soils.

Ask for an engineer to call, or write for publication, *"Concrete Supported Railway Track,"* for details of design and construction.

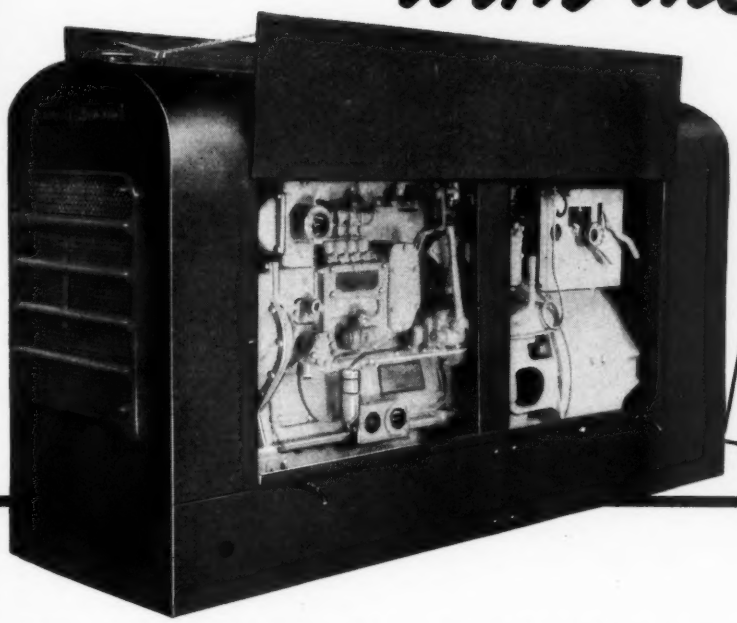
PORTLAND CEMENT ASSOCIATION

Dept. 10-27, 33 W. Grand Ave., Chicago, Ill.

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

IN YOUR 1940 MAINTENANCE PROGRAM

Cut WELDING COSTS with the NEW G-E "Caterpillar" Diesel-driven Arc Welder



IF your 1940 plans include welding for general maintenance on track and structures, don't fail to investigate the new G-E "Caterpillar" diesel-driven arc welder. It's the lowest-priced welder providing both the inherent fuel economy of a diesel and the dependable performance which permits this economy to be *fully* realized.

"Caterpillar" Diesel Engine

Here's why the "Caterpillar" diesel engine is outstanding for welding service:

(1) Gasoline engine starter provides easy starting, even in cold weather.

(2) Simplicity—only three working adjustments, none on the fuel system.

(3) A fuel system which burns a wide range of diesel fuels with smooth idling, fast pickup, and reliable operation.

(4) Woven fuel-oil filter prolongs useful life of fuel injection pumps and valves.

(5) Force-feed lubrication with a separate oil cooler and a two-stage filter assures adequate lubrication, increases oil life, and avoids excessive maintenance.

(6) Special oil-bath air cleaners on both diesel and starting engine assure clean combustion air and prolong engine life.

(7) An engine-mounted radiator and an automatic thermostat make for a trouble-free cooling-water system.

(8) An hour meter indicates when various engine parts should be lubricated.

G-E Welding Generator

Time and electrodes ordinarily account for over 80 per cent of the cost of arc welding. The G-E welding generator provides the following two essential electrical characteristics which produce attractive savings in these two important cost items:

(1) Instant recovery of voltage to more than 100 per cent of the arc voltage required at any current—permits easy striking and maintenance of the arc—prevents time-wasting arc pop-outs, even on vertical welding.

(2) Limitation of current peaks to 250 to 275 per cent of steady short-circuit current—permits quick striking of the arc and efficient deposition of metal—avoids excessive weld spatter, also sluggishness and sticking of the electrode.

The reliability and over-all welding economy of G-E "Caterpillar" diesel-driven welders have been proved. The first unit has been in successful operation for more than a year. Ask your G-E transportation representative for further information.

GENERAL ELECTRIC CO., SCHENECTADY, N. Y.

G-E ELECTRODES CUT COSTS, TOO

G-E electrodes may be used on work requiring approval by the Hartford Steam Boiler Inspection and Insurance Co. and other recognized authorities. Frequently used in railroad work are:

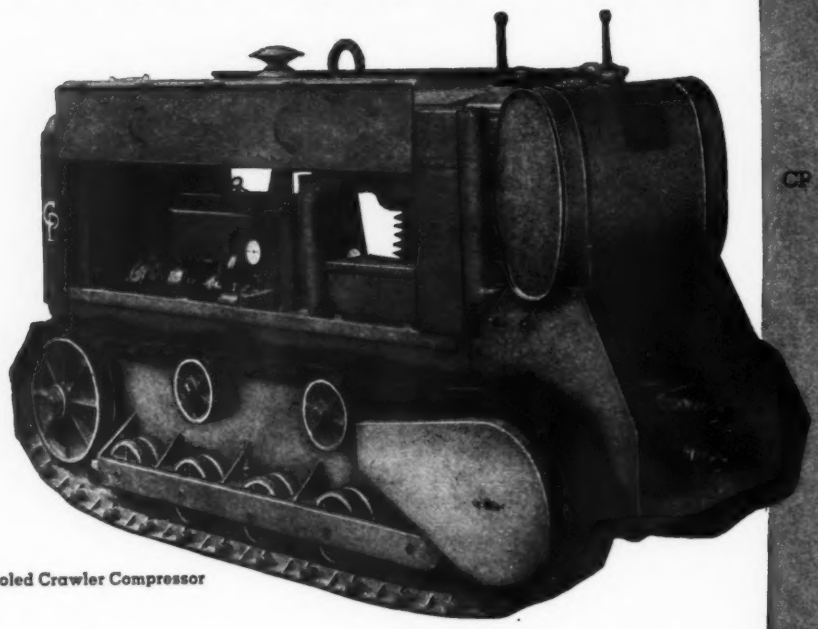
W-90 for rail-end batter
W-84, -85 for frogs, crossings
W-22 for bridges
W-20 for maintenance, repairs

Write for *Arc Welding Electrodes*, GEA-1546. It gives valuable information on all types and procedures for mild steel, high-tensile steel, and cast iron.

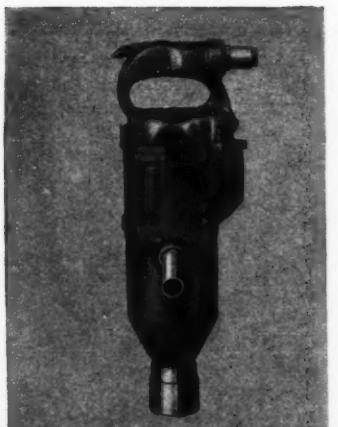
GENERAL ELECTRIC

THESE CP SPECIALTIES

WILL HELP YOU CUT MAINTENANCE COSTS



CP Air-Cooled Crawler Compressor



CP "Power Vane" Wrench

CP Tie Tamper

Designed primarily for maintenance of way service . . . capable of climbing 40% grades and traveling between or across the rails or on the track shoulder . . . CP Two-Stage Air-Cooled Crawler Type Compressor is the ideal unit for track work. Also available flanged wheel mounted (self-propelled); gasoline or Diesel driven.

For "nipping" and on small rises, as well as for tamping jobs where the track is raised several inches there is no better tamper than the low air consumption, low maintenance CP 3-D.

With a CP-365-R "Power Vane" Reversible Wrench you can materially reduce the time and cost of screw spike driving and the application or removal of nuts on frogs, switches, fish plates and trestles.

Write for complete data on CP Maintenance of Way Equipment.

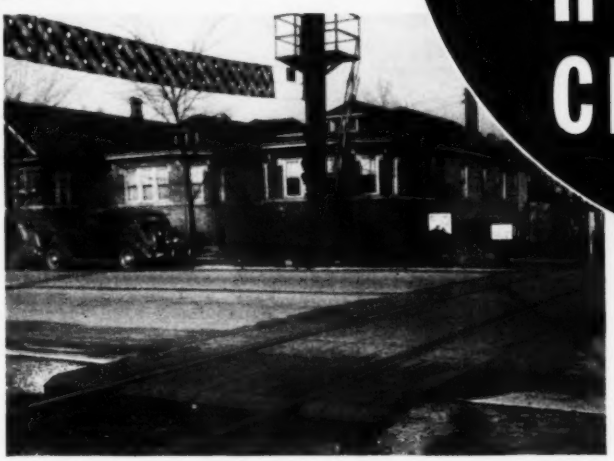
Visit our Booth at
55th Annual Convention of the Roadmasters and Maintenance of Way Association, Chicago
Oct. 10th, 11th, 12th

CHICAGO PNEUMATIC TOOL COMPANY
General Offices: 6 EAST 44th STREET, NEW YORK, N. Y.
SALES OFFICES AND SERVICE STATIONS THROUGHOUT THE WORLD

CP EQUIPMENT
FOR MAINTENANCE OF WAY

TRY MOSS *Ready-Made* SECTIONAL HIGHWAY CROSSINGS

Close-up of a recent installation before the leveling off ballast has been applied. This crossing is 24 feet wide, calling for twelve 8-ft. sections.



FOR LASTING SERVICE

LOW FIRST COST—LOW MAINTENANCE

Today, after nine years in continuous service, carrying dense, heavy-tonnage motor vehicle traffic . . . scores of Moss Crossings are just as smooth . . . just as firmly in place as the very day they were laid . . . There is very little evidence of wear . . . and conservative estimates of service life, by railway engineers indicate a minimum expectancy of 20 years.

Basically, the sections comprise three **BLACK GUM** timbers milled to fit individual rail sections . . . and assembled to conform to local conditions . . . Precision methods insure exact dimensions of thickness and length . . . longitudinal chamfering to eliminate abrasion from railway rolling stock . . . to provide tight fitting sections over tie plates, rail base and fastenings . . . as well as end chamfering to eliminate hazards of dragging equipment.

Complete crossings are delivered to the job in convenient sections ready to set in place . . . installation is simplified . . . No special equipment or material is required . . . a small track gang does the work . . . and there's no need to detour highway traffic.

Timber Experts declare that black gum withstands abrasion, impact and wheel loads of today's highway traffic as well as or better than any other known species . . . Produced from Moss timberlands in the South . . . properly seasoned . . . completely pre-framed . . . and thoroughly creosoted . . . it insures smooth crossings of low initial cost, low maintenance cost, and a long life expectancy.

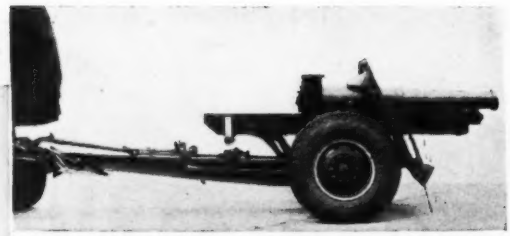
T. J. MOSS TIE COMPANY

Security Building

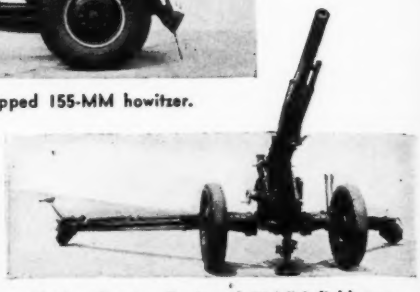
ST. LOUIS, MISSOURI

The Stamp of Character MTC FOUNDED 1879

Timken Bearing Equipped 155-MM gun.



Timken Bearing Equipped 155-MM howitzer.

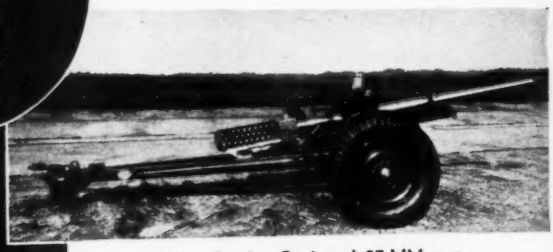


Timken Bearing Equipped 75-MM field gun.

For Defense

Wherever wheels and shafts turn, the extra strength, endurance and accuracy of TIMKEN Bearings are facilitating the mechanization of our military forces . . . both in the equipment itself and in the precision machinery necessary to produce it.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

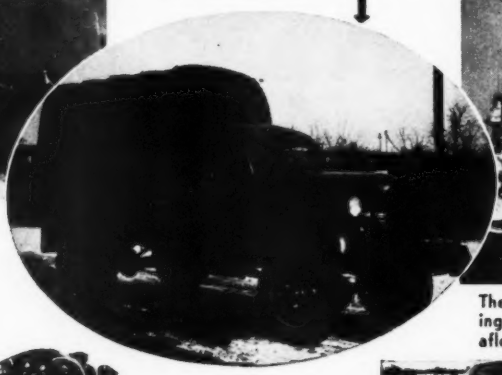


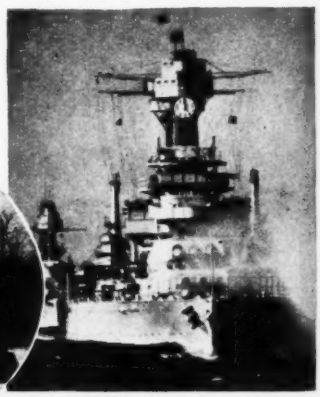
Timken Bearing Equipped 37-MM gun.

Timken Bearing Equipped light tank. ➡

Timken Bearing Equipped 4-ton truck. ⬇

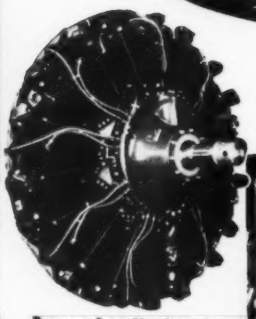
Timken Bearing Equipped 1½-ton truck. ⬇



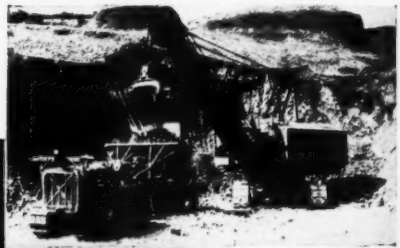


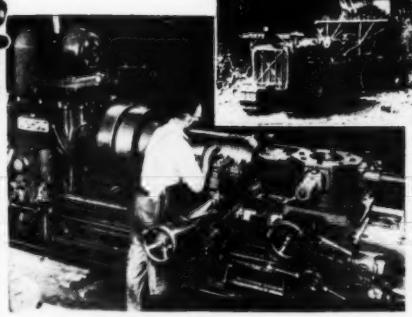
The U. S. Navy uses Timken Bearings in many kinds of equipment afloat and ashore.

U. S. military airplanes take off and land on Timken Bearing Equipped wheels.



Power for U. S. war birds—Timken Bearing Equipped engines.





U. S. Army Engineers use a wide variety of Timken Bearing Equipped machines.

Millions of dollars worth of Timken Bearing Equipped precision machine tools will speed up our vast defense program.

PITTSBURGH SCREW & BOLT

GIANT GRIP

REINFORCING DRIVE DOWELS

● No need now for rejects due to splitting! Here is an actual photograph of ties that were doweled green, and treated at end of seasoning period. In creosoting plants, ties, which show a tendency to split, can be completely salvaged before treating by using GIANT GRIPS. GIANT GRIPS are available in diameters, 1/4" to 7/8", any required length. *Samples sent upon request.*

PITTSBURGH
SCREW AND BOLT CORPORATION
PITTSBURGH, PA.

GARY
SCREW AND BOLT COMPANY
GARY, IND.—CHICAGO, ILL.

American Equipment Corp. . . . . Norristown, Pa.

DISTRICT OFFICES: International Building, New York, N. Y. . . . . General Motors Building, Detroit, Michigan . . . . . N. B. C. Building, Cleveland, Ohio . . . . . Post Office Box 222, Savannah, Georgia . . . . . Republic Bank Building, Dallas, Texas

No. 142 of a series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

October 1, 1940

Subject: Men Make Associations

Dear Reader:

As I have watched the preparations that the officers of the Roadmasters and the Bridge and Building associations have been making for their conventions this year, I have realized anew that "men make associations." I recognize, of course, that conditions in the railway industry change from time to time and that in so doing they exert an influence on the work of associations and attendance at their conventions. Retrenchments and reductions in forces place added responsibilities on supervisory officers and make it difficult for them to leave their territories. Conversely, enlarging programs increase the need of supervisory officers for information regarding new developments in equipment and materials and stimulate interest in conventions and exhibits.

Yet, I am sure that you will agree that even more important than these changes in general conditions is the character of leadership that an association receives, a leadership that stimulates work by others in committees and elsewhere—a leadership that presents programs that are forward-looking in scope, pointing out trends and meeting the changing problems of the day.

The engineering and maintenance of way department is fortunate in the type of leadership that the associations in this branch of railway service have long enjoyed. The American Railway Engineering Association is unique among technical organizations in the number of men who give so freely of their time to its work in committees and otherwise; it is equally outstanding in the authoritative character of its Manual and Proceedings. And after 41 years this organization is still gathering momentum.

In lesser degree only, the Roadmasters and the Bridge and Building associations have also rendered outstanding service to the railways for 55 and 47 years, respectively. Their Proceedings likewise form unusually complete records of the trend of practices in their respective fields, while the programs for their conventions this fall show the virility which still pervades these organizations.

I am sure that you agree with me that these organizations have rendered remarkable service to the railways—service that has done much to expedite the universal adoption of new and better materials and more efficient methods of working. And the leadership that these organizations now enjoy, if perpetuated, will continue to foster and stimulate progress in the future. It is with the desire to co-operate in this work that we are devoting so much space in this issue to the proceedings of the Roadmasters Association, and will devote corresponding space next month to the activities of the Bridge and Building convention.

Yours sincerely,

Elmer T. Howson

ETH:EW

Editor

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

New, Improved FLEX-TOE Claw Bar

Now 2 Men Can Do the Work of 3

(Space 87 at Road-masters Convention)

(Track Supply Association Member)

One man alone pulls spikes with a Flex-Toe Claw Bar. Movable toes of the bar grab hold tightly to the shaft of a spike and with powerful leverage applied on the short fulcrum the spike COMES OUT.

HE NEW, improved Flex-Toe Claw Bar is a labor saving, time saving, safety tool for track gangs. It eliminates the need for spike maul driving. One man hout a helper pulls spikes with or without heads, and drift bolts with ease.

Flex-Toe is thrown onto spikes into the same position as the old, conventional . The open toes grab hold automatically the instant the handle is pulled. The ter the pull the tighter they hold, hence they will not slip off the spikes. There no adjustments to make.

Since driving with a spike maul is largely eliminated, reducing the hazard of g chips; since the Flex-Toe will not slip off spikes, causing men to fall; and e only one man without a helper can pull even headless spikes, your gangs will e fewer accidents and your maintenance costs will be reduced.

Six Spike Pulling Features

1. A ONE-MAN TOOL—easy to carry—no driving with spike maul or sledge—used as old, conventional claw bar—nothing new to learn.
2. Pulls HEADLESS spikes and drift bolts.
3. Moving gripper toes grasp and bite spike or bolt automatically when bar is thrown into position. Toes sink sharp edges into metal—act like powerful shears, hold TIGHTLY. Toes will not get under the rails.
4. No shop redressing. Tough, forged, heat treated alloy steel toes—replaced in less than two minutes right on the job—simple construction—foolproof.
5. Operator takes a series of tight holds at any point along the shaft of spike or bolt.
6. Driving with spike maul largely eliminated—personal injury hazard from flying spike heads and metal chips reduced—injuries from falls and hands striking opposite rail reduced.

WRITE TODAY FOR PRICES AND FURTHER INFORMATION

The Flex-Toe Bar with open toes is easily thrown on the spike, biting beneath the head or anywhere along the shaft.

2 Leverage on the handle closes the toes automatically, gripping tightly both sides of the spike.

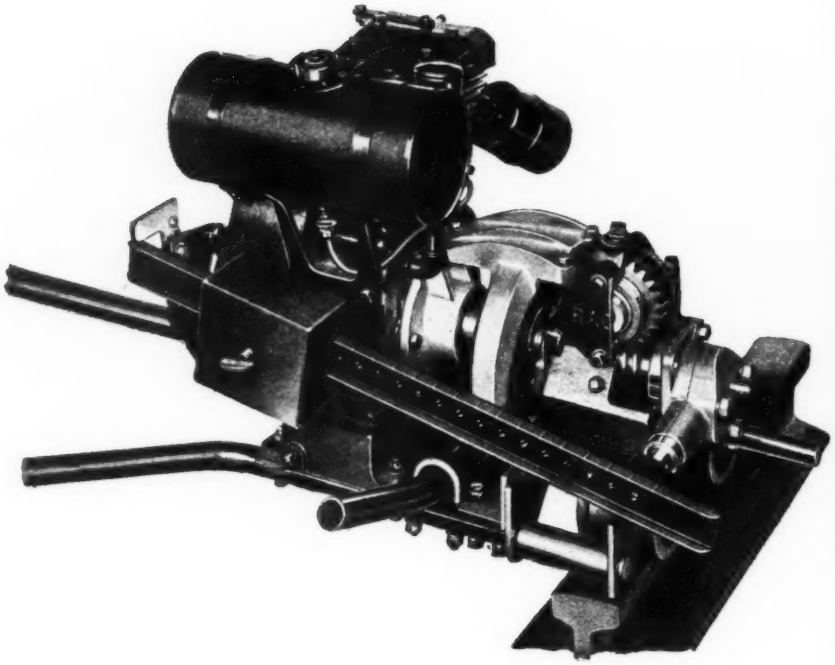
3 Powerful leverage . . . acting on a short fulcrum . . . puts full force of muscular strength into the pull.

4 Repeated bites may be taken along the shaft of the spike to pull it straight out.

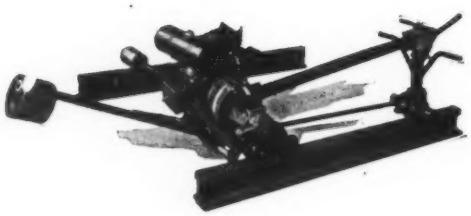
Patent No. 2,026,581

ARREN TOOL CORPORATION - *Warren, Ohio*

Positive and Uniform Torque Control



The 1940 Raco Power Track Machine, incorporating the new Micro Cutout, accurately measures torque applied to the nut. Tests have shown it accurate to within 3%.



The Raco Micro Cutout and Dynamometer operate in the same manner as a platform scale. The weight is set on the dynamometer arm as the weight is set on the beam of the scale. The load is applied through the micro mechanism, same as to the platform of the scale. When equality between the two is reached, the dynamometer tilts, or floats, as does the scale beam. The tilting action causes the driving and driven plates of the Raco Machine to separate instantly, cutting out the power.

RAILROAD ACCESSORIES CORPORATION

Main Office

137 East 42nd Street
(Chrysler Building)
New York

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
1081 National Press Bldg.

SEATTLE
1038 Henry Bldg.

SAN FRANCISCO
485 California Street

LOS ANGELES
Union Bank Bldg.

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Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3, 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.)

PRINTED IN U.S.A.

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

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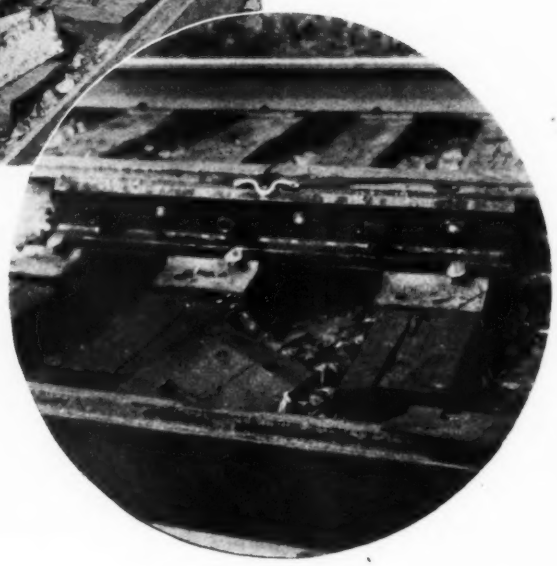
Left: Showing the method of placing moulded block of plastic preservative on joint bar before application to rail.

Center: Applying joint bar in the conventional manner.

Below: Joint bar bolted to rail. Note how the high pressure, as the bolts are tightened, squeezes the preservative to all points in the splice.



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Railway Engineering and Maintenance

Freight

An Outstanding Achievement in Service

IN 1926, Herbert Hoover, then Secretary of Commerce of the United States, stated that "probably the most outstanding single industrial accomplishment since the war has been the reorganization of our American railroads." Gratifying as this commendation was, developments since that time show that the accomplishment that Mr. Hoover referred to was only the beginning of a major transformation in the railway industry that has revolutionized its service to a degree that is but slightly appreciated by shippers and even by railway employees and that is almost unknown to the public at large.

Measures of Achievement

For illustration, in the year 1919 (after the end of the great war) the railways of the United States were operated by the government. They had 2,400,000 freight cars; but during the latter part of that year there was a "car shortage." In 1929 they handled 20 per cent more freight with fewer cars; but there was no car shortage. In 1939 they handled 91 per cent as much freight as in 1919, and as much in the latter part of the year; they had 690,000 fewer cars; but there was no car shortage.

The average speed of freight trains in 1919 was 10 miles an hour; in 1929, 13.2 miles; in 1939, 16.7 miles.

In 1919 the average number of tons handled per train was 637. In 1929 it was 804. In 1939, in spite of much higher speeds, it was 813.

In 1919 railway operating expenses were 4 billion 400 million dollars. In 1929, when 20 per cent more freight was handled, they were 4 billion 500 million dollars. In 1939, when traffic was almost equal to that of 1919, they were only 2 billion 900 million dollars—34 per cent less than in 1919 in spite of higher wages.

In 1919 shippers paid the government 3 billion 600 million dollars for their railway freight service and the government incurred a large deficit which had to be paid in taxes. In 1929, under private operation, they paid 4 billion 800 million for that service. In 1939 they paid only 3¼ billion dollars for it. And in 1929 and 1939 there were no deficits for the taxpayers to meet.

In 1920 manufacturers' inventories were about 14 billion dollars. In 1929, because of the improvement in railway service, they had become able to reduce them to about 9 billion dollars. The average annual cost of carrying inventories being about 25 per cent, this effected an annual saving to the manufacturing industry alone of about 1¼ billion dollars. During the depression manufacturers' inventories have been even lower, with continuing annual savings of probably ¾ of a billion to 1 billion dollars.

Aids to Industry

These figures demonstrate the remarkable improvement the railways have made in the handling of freight during the last 20 years. It is an improvement in the service rendered shippers. They are the beneficiaries in faster transportation, in more dependable service, in cheaper transportation, in more convenient service and in other ways that cannot be measured statistically.

Take the question of car shortages. A couple of decades ago the shortage of cars was a regular accompaniment of the peak traffic each fall. In those times, shippers were forced to wait days or weeks for cars in which to load their products, adding materially to their expense of doing business and frequently losing sales. Consignees faced similar problems at the receiving end and were forced to accumulate inventory to anticipate their needs. But such conditions prevail no longer, for the shipper knows that he can secure the cars he needs when he needs them, an assurance that adds much to the stability of business.

And the greater speed with which traffic moves adds much to the distance over which much freight, especially perishable, can be moved. Last year was the first year in history in which the average distance traveled per freight train per day exceeded 400 miles, the 1939 figure being 401. This speed was 62 per cent greater than the 247 miles made in 1920. It was reflected in the large and rapidly growing number of trains making first-morning deliveries of freight over areas as remote as 350 and 400 and even 450 miles from central markets. And this service, incidentally, enlarged the scope of these central markets correspondingly while bringing centers hours and even days closer together. In other words, this faster freight service is shrinking the country commercially to a very marked degree and expediting commerce accordingly.

This faster rail service between the larger centers has been extended also to thousands of smaller communities by means of co-ordinated rail-highway movement, with full cars loaded to set-out points, beyond which the traffic is carried on highways fanning out to many communities.

And in improving their service the railways have not overlooked the convenience of the shipper, for they now offer him in one transaction a complete service from his shipping platform to the door of his customer. This has been made possible through the installation of pick-up and delivery service, the value of which is indicated by the large volume of package freight that it has been instrumental in returning to the rails.

The railways are an essential part of every industry, for without efficient railway transportation the radius of operations of that industry are closely circumscribed. To the extent that the efficiency of railway operation has improved, its contribution to the efficiency of all industry has been increased.

This contribution to the welfare of the country warrants more widespread appreciation and more widespread publicizing among the public at large than it has received to date in order that shippers and the public may appreciate the remarkable service that they are receiving today, for if their attention is not called specifically to it, they are prone to accept it as a matter of fact. This places a responsibility on railway employees to see that those with whom they come in contact are told of this achievement.

Fencing

Should Not Be Entirely Overlooked

THE last eight or ten years have witnessed minimum attention to the upkeep of right-of-way fences. This is not surprising as maintenance of way officers have been confronted with the problem of obtaining even enough money for the proper upkeep of their tracks, bridges, terminals and station facilities during these years. However, with claims for stock losses still high on the railways as a whole, and on some roads out of line with the expenditures that would be involved for fence construction and repair and proper employee attention to prevent them, the upkeep of fences cannot be neglected beyond a certain point without financial loss to the railways, not to mention the additional hazard to train operation.

The fact that funds may not be available for a large program of this character, or for materials for even an adequate program, is no excuse for the complete neglect of fences, and any supervisory officer who allows his men to get into the frame of mind that just because new repair materials are not available, they are relieved of responsibility for doing everything possible to keep fences tight, farm gates closed, and stray stock off the right-of-way, is making a mistake that will be reflected in losses which would not otherwise occur. Without other than normal expenditures for fence repairs, one road, by a concerted drive among its employees, has reduced the number of head of stock killed on its right-of-way almost two-thirds, or from a total of 6,161 in 1934 to 2,095 in 1939, representing a reduction in claims which cannot be ignored.

In the further interest of economy in fence maintenance, greater attention may well be given to the abandoning of sections of right-of-way fence where they are not required by law and no longer necessary for stock protection, especially along hard-surfaced highways. In these locations, where pastures and fields are enclosed on the far side of the highway, and where the danger of killing stock on the right-of-way is not a factor, the removal of the fence not only precludes further maintenance costs on it, but frequently makes available large quantities of strand and barbed wire, woven wire fencing and posts for repair work at other points. These are factors which maintenance forces might well keep in mind at all times, and especially during the fall of the year when most roads are planning fence repair programs for the winter months.

Rail in Yards

Faster Freight Service—Better Tracks

MAINTENANCE-OF-WAY officers from chief engineers to section foremen are acquiring new viewpoints with respect to track maintenance, at a rate that sometimes leaves them bewildered but which generally results in better track conditions. In no way is this changing outlook demonstrated more clearly than in the construction and maintenance of yard tracks. It has not been many years since almost any kind of rail, even that bordering on scrap, was considered suitable for yard use, and men who are relatively young in service can remember the difficulties under which they often labored to keep leads, ladders, running and body tracks in reasonably safe and dependable condition. Few yards of consequence are today afflicted with the extremely light rail, poor ties and under-maintenance that were so common only a few years ago. Yet observation indicates that in only a few instances has the standard of track maintenance been raised to the level that the importance of this facility warrants, this being particularly true with respect to rail.

We are today definitely in an era of speed that embraces freight as well as passenger service. Shippers' demands are insistent that service shall be dependable as well as fast. Competition makes it imperative that these demands be heeded, and the railways are already developing a streamlined freight service that in many ways corresponds to the streamlined passenger service that is now out of its initial development stage. To maintain this faster service, however, an elementary requirement is that cars must be moved through switching yards at a rate that corresponds to the shortened road schedules, for the competition with which the railways are faced is keen, and every minute counts in the movement of traffic.

Under these conditions delays to the movement of cars in passing through yards can no longer be tolerated, for delays in yards make necessary still higher speeds out on the line, if the shortened schedules are to be maintained dependably. While the responsibility for speedy, uninterrupted movement through yards rests primarily on the yard operating organization, the maintenance-of-way department cannot escape its share of responsibility if delays and interruptions are caused by defective track. Delays resulting from defective track are indefensible from any point of view. Yet, dependable track cannot be maintained unless materials are provided that will stand up in the service for which they are intended.

While some roads have maintained a relatively high standard of track construction in yards, in general, as has been mentioned, one of the serious defects in yard construction has been light rail. In the new era of trans-

portation into which we have entered, and from which there can be no retreat, light rail is no more suited for leads, running tracks and ladders than it is for main-track service. In fact, not a few maintenance officers are advocating the use of No. 1 relayer rail for these tracks and a few go further and say that new rail should be laid on ladders whenever the present rail requires renewal. This implies the application of tie plates and anti-creepers and the maintenance of good line and surface.

The railways are committed to improve freight service, one feature of which is shortened schedules. Not a few roads are already surveying their needs for heavier rails in main tracks to insure that the higher speeds which these shortened schedules entail will be made safely and dependably. Since the switching yard is the heart of freight-train operation, it is equally important that freedom from track defects shall extend to this facility. One of the best forms of insurance against delays arising from poor track is heavy rail and the application of incidental fastenings—tie plates and anti-creepers—that are now considered essential to main-track construction.

Crossings

Safety Demands Flanges Be Kept Open

HIGHWAY crossings at grade are afflicted with several potential hazards, none of which is inherent in the crossings themselves, but becomes a hazard through carelessness or neglect. No motorist need be killed at a grade crossing, and the many fatalities that occur at such crossings can be traced to carelessness or to neglect to take the most elementary precautions when approaching a point of known danger. Another type of hazard, which does not involve the drivers of highway vehicles, may be more disastrous in the magnitude of its effect, than a collision between an automobile and a train. This is the hazard created by packed flangeways.

While a packed flangeway may occur from several causes and at any time, it is more likely to occur during the winter, and is one of the most serious conditions encountered during this season. In general, snow and ice are at fault but, if the highway is not improved, it is not uncommon for wheels to drop relatively large chunks of mud on the crossing surface during warm spells, which tend to work into the flangeways. When frozen, such accumulations become hard enough to lift wheel flanges over the rail.

Another hazard occurs in connection with the clearing of snow from the highways. Unless a co-operative arrangement can be worked out, highway snowplows are likely to drag large quantities of snow onto crossings, which, because of its volume, creates a hazard of considerable magnitude. In addition to packing the flangeways, this snow will also become packed over the crossing surface, and only a slight thaw followed by a freeze may make the crossing so slippery that vehicles may skid.

Because of the possibility of derailments resulting from the passage of snowplows unannounced, some supervisors have developed co-operative arrangements with the local representatives of the highway department, whereby notice is given of the probable passage of snowplows over the crossings. The section forces then clear the crossings at once and level down the snow on both sides of the track. In this way, the problem of keeping flangeways open after a storm and all during the winter has been greatly simplified.

Rail Weight

A Record of Surprisingly Slow Growth

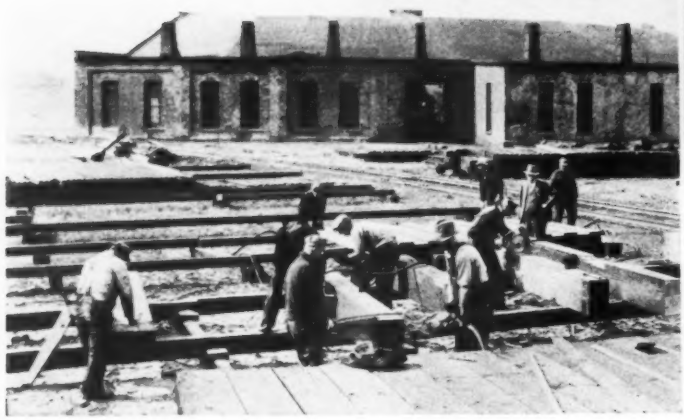
RAIL is a fascinating study, no matter what phase of the subject is considered, and none is of more interest than its growth in size and weight. On page 573 of the September issue there was published a chart which shows that the average weight of rail rolled for the American railways increased from 50 lb. in 1880, at a nearly uniform rate of 1.2 lb. annually, to 122 lb. in 1940. On the same page is a table which shows that between 1920 and 1938, both inclusive, the average weight of rail in the main tracks of the Class I roads increased from 82.24 lb. to 94.15 lb. at an average rate of 0.66 lb. annually.

Reference to the chart and table shows that whereas the rate of increase in the weight of rail rolled year by year varied only slightly from the average, the increase in the weight of rail in service did not adhere as closely to the average, having ranged from 0.29 lb. to 1.19 lb. Superficially this seems to be inconsistent; yet when the several factors that have influenced the increase in the weight of rail in service are taken into consideration this inconsistency disappears.

Obviously, the average weight of rail in service will increase more slowly than the weight of rail rolled, no matter at what rate the latter increases, for only a small part of the total mileage of track is relaid in any year. It is equally obvious that there will be fluctuations in the weight of rail in service by reason of fluctuations in the total amount of rail rolled, as well as because a larger amount of new rail will replace rail of the same weight in some years than in others. Fluctuations that affect the average will also occur in the weight of the rail replaced by the new rail or by the released rail when it is relaid, or by both.

One of the most prominent features of rail in the past has been its inadequacy to sustain the wheel loads imposed upon it. It has been only during the last decade that the railways as a whole have been persuaded that this is so. It is apparent to every student of the subject that up to the present, rail growth has been surprisingly slow. It becomes a matter of interest to consider whether the rate of increase since 1920 will be sufficient to meet the future requirements of the railways.

Right—General View of the Whirl Pool Rapids Bridge from the Canadian Side. Below—View of the Framing Operations



Power Tools S

When the Canadian National recently undertook an extensive bridge-deck renewal project, made necessary by the need for replacing metal pans protecting a highway deck underneath its tracks, it felt warranted in purchasing a complete complement of portable power tools especially for this project. This project, which is described in detail in this article, is also of interest because of the design of the new pans installed

TIMBER framing and construction problems and details of an interesting nature were encountered by the Canadian National during the course recently of an extensive bridge-deck renewal project. Involving a bridge having a total length of 1,081 ft., this project was undertaken primarily for the purpose of replacing existing metal pans or plates protecting a vehicular roadway underneath the railroad deck with new pans of a different design. It also involved the renewal of all the bridge ties, of which there are a total of 1,308 in the new deck.

The latter phase of the project necessitated a large amount of timber-framing work, much of it of an exact and complicated nature. As a measure of the extent of this work, it may be noted that it entailed the boring of about 8,200 lin. ft. of holes in the ties for the track fastenings and hook bolts and the making of approximately 14,000 saw cuts. The plan of procedure in carrying out this project called for the performance of practically all the framing work in the field and, while making preparations for starting the work, the railroad came to the decision that, in view of the large amount of framing work involved, it would be justified in purchasing a complete complement of portable power tools especially for use on this job. This was done, and it is estimated that the savings effected on this project alone were sufficient to pay for the machines.

Description of Bridge

The structure involved in this project, which is owned by a private corporation, is the so-called Whirl Pool Rapids bridge across the Niagara River gorge between Canada and the United States at Niagara Falls. It is a double-deck structure with two railroad tracks on the upper deck, which is used by the Canadian National, and a vehicular roadway beneath. The central span in the bridge is a structural steel arch having a clear span of 550 ft., while at each end there is a deck-truss approach span 115 ft. long. Also, at each extremity of the structure there are three additional spans totaling 150 ft. in length. Thus, the total over-all length of the bridge is 1,081 ft.

The track-supporting structure on the upper deck of the bridge embodies transverse floor beams at the panel points, into which are framed four lines of longitudinal stringers, two under each track. The deck construction is of the open type and to prevent rain water, brine drippings, locomotive cinders and other matter from penetrating through to the roadway, canopies are incorporated in the railroad deck, which consist of two continuous lines of metal pans, one at each track. These pans are inclined toward the sides of the structure and drain into longitudinal metal gutters that carry the water to downspouts placed at the panel points. Three timber walkways are provided on the railroad deck of the bridge, one on the outside of each of the tracks and one in the inter-track space.

Old Pans Below Ties

Prior to the recent renewal project, which was carried out in the fall of 1939, the canopy at each track was composed of a series of flat sheets

Left to Right—Cuts for the Deeper Daps and for Trimming the Ties to Length Were Made with a Pneumatic Cut-Off Saw.—A 4-in. Power Hand Saw Was Used for Making Cuts for the Daps and Where Wood Was Removed to Reduce the Depths of the Ties.—The Daps Were Cut Out and Smoothed with Two Chipping Hammers Fitted with Special Cutting Heads

Save Money

On Long Deck-Renewal Job

arranged below the bridge ties and on top of the stringers, the desired inclination toward the side of the bridge being imparted by means of timber shims on the stringers. The shims included a longitudinal timber placed directly on top of each stringer, that on the inside stringer at each track being 3 in. in thickness and that on the outside stringer being 2 in. thick. These timbers were fastened to the top flanges of the stringers by countersunk bolts. The pans, which were of copper-bearing steel, were placed directly on these timbers, and to provide a level bearing for the ties each of them was supported on two shim blocks placed on the pan over the stringers. The shim blocks on the inside stringers were 2 in. thick and those on the outside members were 3 in. in thickness, thus bringing the total thickness of the timber shims on each stringer to 5 in.

The original pans were installed on the bridge in 1919, and had become badly corroded by brine drippings, particularly under the westbound track over which switching movements are especially heavy. It was decided, therefore, to replace the old plates, employing canopies of the same general type except that the new pans were to be placed on top of the ties, in which position they would be more accessible and would also serve as a protective agency for the ties. In addition, the plates could be so formed as to serve as tie spacers.

Since they were not in need of replacement, the existing longitudinal troughs along both sides of the structure were not involved in the renewal project. These troughs, which are 2 ft. 9 in. wide and 1 ft. deep, are suspended from the bridge deck by means of hook bolts which, along the inner edges of the troughs, are hung from the flanges of the stringers, while along the outer edges they are suspended from the bridge ties.

The New Pans

The new protection system at each track is comprised of individual plates 10 ft. long, measured at right angles to the track, and of sufficient width to cover two ties and two of the spaces between ties. Since the ties are 10 in. wide and the standard clear spacing between them is likewise 10 in., the width of the individual sections is for the most part 3 ft. 4 in., although, because of variations in the tie spacing at certain points, not all of the sections conform to this width. Although the old pans were comprised of flat sheets, the new pans, which are of 3/16-in. copper-bearing steel, are so formed, using right-angle bends, that the portions covering the spaces between the ties are depressed 1¾ in., thus providing troughs that act as tie spacers and also facilitate drainage.

Joints between adjacent sections are formed by the overlapping of 1½-in. right-angle lips that are provided along both transverse edges of each pan. Along the edge of the section that consists of a trough the lip is bent upward, whereas at the opposite edge of the pan, which consists of a raised section, the lip is bent downward. Hence, at each joint the lip of the raised section extends over and envelops the lip of the trough in the adjacent section. To give the outside raised section on each plate sufficient width for this purpose it is made 10-3/16 in. wide, thus making the exact width of the standard plate 3 ft. 4-3/16 in. Copper nails were used for fastening the edges of the plates to the ties.

To produce a lateral gradient in the

pans for drainage purposes, the daps in the ties at the outside stringers were made about one inch deeper than those at the inside stringers. To overcome the difference thus introduced in the elevation of the ties at the rails, 5/8-in. steel shim plates were inserted under the tie plates in the outside line of rails in each track. The tie plates that were installed on the bridge as a part of the project are of a special type, known as the Hill rail fastener, which is designed to hold the rails against creepage. This device consists of a double-shoulder tie plate embodying two clips, one on each side, and involves the use of small steel wedges for applying pressure through the clips to the rail base. Each tie plate is lagged to the tie by four 3/4-in. round steel spikes or dowels.

Deck Construction

The new ties are of untreated British Columbia fir. The ties are 13 ft. in length, except for each third tie, which is 16 ft. long to provide a support for the walkways along the sides of the bridge deck and in the inter-track space. The 16-ft. ties in the two tracks are placed directly opposite each other and at their inner ends they are fastened together by means of bolted timber splice plates. Each of these ties is also held in position by means of two hook bolts which engage the flanges of the floor beams.

Throughout the length of the bridge the tracks are on a level grade, and, since the bridge has a slight camber and embodies certain slight irregularities in the floor beams and stringers, the depth between the base of rail and the tops of the floor beams is subject to considerable variation at different points on the bridge. Because of this situation, it was necessary to use ties of different depths, varying from 14 in. to 20 in.

Obviously, the daps in the ties also varied considerably in depth, and to insure the desired degree of accuracy in making them, figures were furnished by the engineering department showing the depth at each tie between the base of rail and the tops of the stringers. In some instances, because of the considerable depth of the daps, it was necessary to reduce the thickness of the ties by removing wood from their under sides between the daps to permit them to clear certain structural members in the bridge deck.

Practically all framing work on the new ties was carried out on the ground at a location on the Canadian side of the river. As mentioned at the outset, the railroad purchased a number of portable power tools for this work,

Two Power Augers Were Provided for Boring the Holes in the Ties for the Lag Spikes and Hook Bolts

which included a 4-in. Skilsaw which was used principally for cutting the daps in the ties; two Chicago Pneumatic wood augers for drilling holes for the tie plate fastenings and for the hook bolts; and two Ingersoll-Rand chipping hammers, which were fitted with specially-formed blades and used for cutting out the daps. For the heavier cutting jobs a Wolf cut-off saw was used. This equipment of the pneumatic type was furnished with air by a 160-cu. ft. compressor.

The special cutting heads that were used with the chipping hammers involved something of an innovation in wood-working tools. These consisted merely of blank chisel heads that were prepared for this work by forging them to a blade width of 3 in. To serve as a hand grip, a short section of small diameter pipe was welded to each blade at a point near its junction with the shank, thus permitting the operator to guide and direct the tool with one hand while supporting it with the other, using the regular grip. These tools were used for both cutting out and smoothing the daps and, since they were designed to deliver 200 blows per minute, their cutting capacity was relatively high.

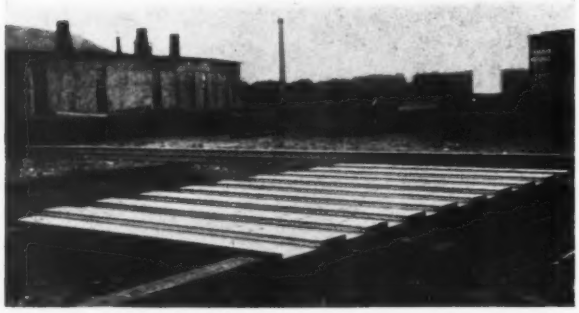
Assembly Procedure

As received at the site of the work, the pans were each numbered to indicate their position in the bridge and also contained the holes for receiving the spikes and the hook bolts. As the framing work proceeded, the newly-dapped ties were assembled in groups at the framing yard in their final position relative to each other and the pans placed on them for use as templates in boring the spike and hook-bolt holes. One-half inch holes were bored for receiving the 3/4-in. spikes. The ties and pans were then ready for insertion in the bridge deck, this work being carried out on one track at a time, beginning at the west or Canadian side of the bridge.

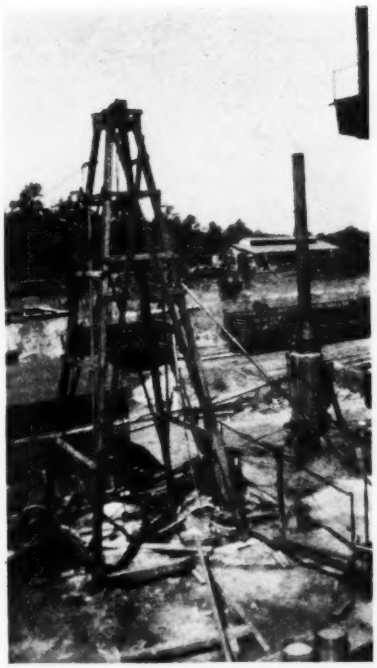
Throughout the course of the project, the work of inserting the new ties and pans was kept abreast of the framing operations, so that the two phases of the work proceeded concurrently. The organization involved, which was divided into a framing gang and a bridge crew, was comprised of a total of 18 men, including 2 foremen, 3 carpenters, 10 bridgemen, and 3 laborers.

As a protective measure, all newly-cut surfaces of the ties in the daps and elsewhere were painted with red or black lead. Before insertion, the pans were painted on their under sides with red lead and after their insertion in the bridge deck they were given a coat of emulsified asphalt on their upper surfaces. During the work on the deck of the bridge, the top surfaces of the cover plates on the floor beams were cleaned with oxy-acetylene torches and then given a heavy coat of red lead. The latter work, as well as the painting of the under surfaces of the pans, was performed by the bridge company, and other work was carried out by railroad forces.

This project was executed under the general direction of C. P. Disney, bridge engineer of the Central region of the C. N. R., and B. Wheelwright, chief engineer, and under the direct supervision of E. C. Neville, bridge and building master.



Showing Several Sections of the New Pans as They Appeared When Assembled at the Framing Yard Prior to Their Insertion



Repairs to the Existing Well Were Delayed Until the Emergency Supply Was in Operation

Prompt Action Saves Serious Water Situation

This article tells how the Illinois Central, without water at Hattiesburg, Miss., as the result of the breaking of a well casing, and faced with the handling of 13 troop trains at that point, the first of which was to begin in 48 hours, remedied the situation by rushing in men, materials and equipment to the scene and establishing emergency supplies

ON August 3, the Illinois Central, faced with the handling and servicing of 13 special trains with 241 cars at Hattiesburg, Miss., on August 5 and 6, moving National Guard units and their equipment to Camp Shelby, 10 miles south of Hattiesburg, found itself completely without water at that point as the result of the failure of its artesian well. Finding that it would be impossible to restore the well to service within the time available, the problem confronting the road appeared serious. However, the water service department rushed men, equipment and supplies to Hattiesburg, laid 900 ft. of 4-in. pipe to a nearby creek and set up two emergency pumping units for delivering boiler water, and laid another 3,000 ft. of 1½-in. and 2½-in. pipe to connections with city mains for coach watering and cleaning purposes. As a result, when the first of the troop trains arrived on August 5, the water situation was completely in hand, and although the demand for water at Hattiesburg was more than doubled during the inward troop movement on August 5 and 6, reaching as much as 180,000 gal. in 24 hr., there was no shortage of water for this movement, or, subsequently, when the troops were moved out.

Hattiesburg is an engine terminal on the single-track Gulf & Ship Island line of the Illinois Central, and a junction point with the line of the Southern railway between New Orleans, La., and Meridian, Miss. It is 90 miles south of Jackson, Miss., and 70 miles north of Gulfport, Miss. Camp Shelby, to which the troop movements were to be made, being located 10 miles south of Hattiesburg, required that all of these movements from the north and east, via both the Southern and the I. C., be handled through the latter point. Furthermore, with no track facilities at Camp Shelby other than a 1,100-ft. siding, and no water facilities whatever, it was necessary that all locomotives and cars involved in the special movements be serviced at Hattiesburg.

Existing Facilities

The facilities at Hattiesburg include essentially a six-stall enginehouse, a machine shop, a blacksmith shop and other auxiliary mechanical department units; the main line, a passing track and an eight-track freight yard; and water supply facilities which were more than adequate to meet the normal requirements at that point, which amounted to approximately 80,000 gal. each 24 hr., including the servicing of an average of 15 road engines each week, in addition to 2 switch engines, each twice daily. Thus, there was adequate trackage to store and service the troop train coaches after they had been unloaded at Camp Shelby, and, under normal conditions, adequate water supply, pumping and delivery capacity to meet the demands of the special movements, which it was estimated would not exceed 180,000 gal. a day.

The water service facilities at Hattiesburg, which are grouped together directly back of the enginehouse and machine shop, near the south end of the yard, include an artesian well, 380 ft. deep, with a flow of 120 gal. per min., into a nearby circular concrete sump, 10 ft. in diameter and 6 ft. deep; a motor-driven centrifugal pump, with a capacity of 200 gal. per min., located in the machine shop and only about 120 ft. from the sump, to which it is connected by a 6-in. suction line; a 100,000-gal. wood water storage tank, which is supplied by the pump through a 3-in. discharge line; and two water columns, serving the main line, the most westerly yard track, and an auxiliary engine lead serving the enginehouse. The only extension of these facilities contemplated in connection with the handling of the troop trains was the laying of approximately 1,200 lin. ft. of 1½-in. wrought iron pipe between the two of the yard tracks for car watering and cleaning purposes, which could be connected with the road's well supply through a 200-ft. pipe connection.

Well Casing Breaks

Without other than this water line to lay, which was to be equipped with 1¼-in. hose connections at intervals of 80 ft. for servicing cars spotted on the various yard tracks, no trouble

The System Well Gang With Its Seven-Car Outfit Was Rushed to Hattiesburg

was anticipated in taking care of the extra train movements on August 5. However, on July 31, concern arose when it was observed that the discharge from the artesian well had fallen off, which examination disclosed was due to a crack in its 4-in. casing, 16 ft. below the ground line. Immediately efforts were made by the division water service forces to determine the seriousness of the break, and to effect repairs. The operating department was advised of the situation and all through trains were bulletined to take water at points north and south of Hattiesburg to conserve the supply, but, with the prospects good that the flow could be restored, concern was not serious until at 1 p.m. on Saturday, August 3, only about 48 hours before the arrival of the first of the troop trains on the fifth, flow from the well ceased entirely.

With this occurrence, which indicated that the only means of restoring the flow in the well was to renew the casing completely, which could not be done under the best of conditions in less than a week's time, plans were put under way immediately to set up an emergency pumping plant, taking water from a creek, the nearest point of which was approximately 900 ft. south of the well. First, the superintendent of water supply of the system was notified of conditions; then the local district water service repairman put in the calls for emergency pumping units which were located at New Orleans and McComb, Miss.; and then, under the plan to pump from the creek directly into the sump, and thus circumvent the well supply entirely, the local forces laid a 2-in. pipe line from the creek to the sump, directly on top of the ground. At the same time, realizing that its coach-servicing supply had been cut with the failure of the well, and could not be replaced with the creek water, an arrangement was made with the city for an emergency connection to one of its 2-in. service lines near the extreme north end of the yard. This connection was made to the 1½-in coach service line laid through the south half of the yard, but only after this line had been moved to the north end of the yard.

Rush Emergency System

While these measures to establish an emergency supply were under way, the emergency pumping units called for from New Orleans and McComb, one a gasoline-engine, belt-drive plunger-type pump, and the other a gasoline engine-driven, 3-in., direct-connected centrifugal pump, were loaded and sent to Hattiesburg via railroad baggage service on the first passenger trains. At the same time, a system office water service inspector was sent to Hattiesburg from the road's headquarters at Chicago, and the road's system well gang, engaged in work at Gilman, Ill., 81 miles from Chicago, was dispatched to Hattiesburg with all of its equipment. This gang, consisting of a foreman and four men, with its complete outfit of 7 cars, including 2 material cars, 2 tool cars and 3 camp cars, left Gilman shortly after being notified, and was dispatched from Champaign, Ill., to Hattiesburg, 560 miles distant, at 3 a.m., Sunday, August 4.

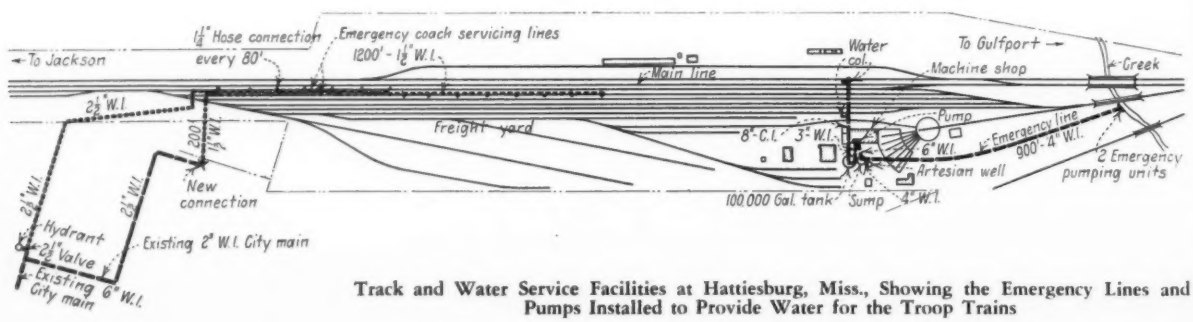
Complete Emergency Supply

Early the following morning, the day of the first of the troop train movements, all repair forces and equipment were on the ground at Hattiesburg. Immediately, the emergency pumping units, each with a capacity of approximately 150 gal. per min., were set up near the creek, one as a spare, and the 2-in. line that had already been laid from the creek to the sump, utilizing the only pipe available to the local forces, was relaid with 4-in. pipe taken from the cars of the well outfit, the smaller pipe being deemed of insufficient capacity. By noon the emergency supply was in full operation, pumping creek water into the sump at a rate exceeding the normal supply from the failed well. As a result, "No water" bulletins were cancelled, and service was afforded to all of the regular and special trains as required, without delay to any of them.

Meet Second Emergency

With the locomotive boiler water emergency met, there remained one other emergency situation to be taken care of. This became evident on Tuesday, August 6, with the beginning of the work of cleaning and servicing the empty troop train coaches which had been moved back from Camp Shelby to the Hattiesburg yard for this purpose, when it was found that the 1½-in. line which had been laid in the yard, and served from the 2-in. city connection, was inadequate to give the hose pressure desired at its far end for the rapid service required. This situation was met promptly by resorting to a second city line connection, several hundred feet north of the first connection, where a 6-in. main could be tapped. From here, a 2½-in. line was run out to the right-of-way.

(Continued on page 644)



Track and Water Service Facilities at Hattiesburg, Miss., Showing the Emergency Lines and Pumps Installed to Provide Water for the Troop Trains

Plywood Panels Are Readily Framed and Installed in Either New Construction or Alteration Work

Employs Plywood Effectively in Building Work

Since about 1930 the Coast lines of the Southern Pacific have been employing Douglas fir plywood in building construction, modernization, alteration and repair work on an increasing scale, and are now using approximately 80,000 sq. ft. of this material annually in these classes of work. The ways in which this material is being used and applied are described in this article

ON an increasing scale during the last 10 or more years, the Coast lines of the Southern Pacific have been making effective use of Douglas fir plywood in a wide range of building construction, alteration and repair work, the use of this material for these purposes in recent years having amounted to approximately 80,000 sq. ft. annually. In fact, this type of construction has been found so effective, practical and economical that there are few buildings built, altered or repaired on the Coast lines today, including passenger stations, which do not involve the use of plywood to some extent for interior wall, ceiling and partition construction, and for doors and certain parts of cabinet work. In addition, plywood is used extensively for concrete forms or for form lining in many classes of concrete construction and repair work, carried out either under contract or by company building forces.

Wall Facing

Some of the most extensive uses of plywood to date have been within store buildings, wash and locker buildings, yard offices and section dwellings, and the office areas of shop buildings and freight houses, although effective use has also been made of this material in club house and dormitory buildings provided at terminal points for the use of engine crews. As a matter of fact, the use of plywood is practically standard construction for walls, ceilings and partitions in offices in shop buildings and freight houses, and is becoming increasingly general in the other types of buildings mentioned. In most cases, except for special considerations, this material has been found practical and durable, with the added advantage that it can be installed readily and economically.

For new wall or ceiling construction, plywood panels, generally 4 ft. wide and 6, 8 or 10 ft. long, are nailed directly to the studs or ceiling joists, finishing nails being used over the face on 12-in. to 16-in. centers along the stud or joist lines, and lath-type nails being used along the edges, spaced approximately 12 in. apart. All joints and edge nails are covered by ⅜-in. battens, from 1½ to 2¼ in. wide, which conceal the joint lines and produce a panel effect. The same size and type of battens are used for mouldings at the ceiling line and elsewhere, as desired, while one-inch quarter-round is generally used at the floor line. In those sections of colder climate on the road, thermal insulation has been installed behind the interior plywood facings of exterior walls with the same effectiveness and with no more difficulty than would be involved in any other type of wall construction.

In modernizing or repairing the interiors of existing structures, the application of plywood is essentially similar to that in new construction, although the plywood is generally laid directly over the existing wall facing, whether of plaster or of wood, without furring strips, and is nailed directly to the old studs or joists. Through this method of installation, the plywood panels lay tight to the old surface, which frequently makes unnecessary the building out of window casements and door frames.

Locker Building

Typical of the use which is being made of plywood for new construction on the Southern Pacific is a shop locker building built recently at West Oakland, Cal. This building, which is 60 ft. long by 32 ft. wide and two stories high, is of frame construction throughout, with redwood V-joint rustic siding and asphalt roof shingles. Within the building, both floors of which are given over to wash, locker, shower and toilet facilities, the first floor is of concrete with a cement finish, while the second floor is of wood with a water-tight mastic surface. Except for a cement plaster

wainscot 5½ ft. high in both the shower room and the toilet room on the first floor, the interior throughout the building is faced with plywood-batten construction, this alone involving the use of more than 8,000 sq. ft.

Throughout the locker building, three-ply panels, ⅜-in. thick, were used, this thickness having been found satisfactory on the Southern Pacific for ceiling, wall and partition construction, and having been adapted as standard for this purpose. For cabinet backing and drawer bottoms, for which a large amount of plywood is also used by the road, three-ply, ¼-in plywood is standard, while for door panels, heavier three-ply material is used ⅜ in. or ½ in. thick.

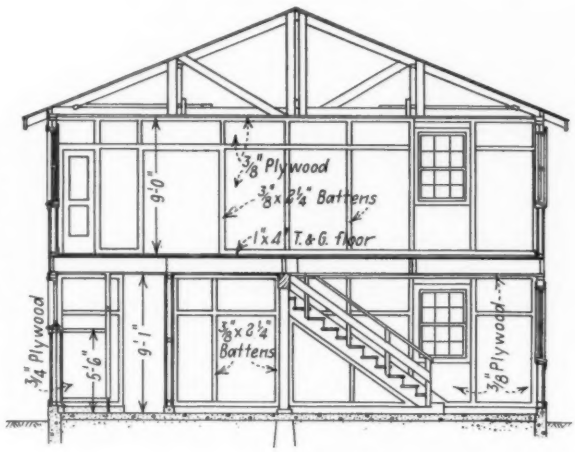
For all of these various interior uses of plywood, the Southern Pacific has found the material not only strong, rigid and durable, but also light in weight, easily worked and readily installed. Speed of erection and a minimum of mess have also been factors in the use of this material, it having been found possible to occupy new buildings with plywood interiors immediately upon their completion, and, in the case of alteration, renovation or repair work, to carry out the work with minimum interference with the normal use of the building.

Interior Finish

Most of the interior installations of plywood on the Southern Pacific are given an oak, mahogany or walnut stain finish as seems best suited under the circumstances that prevail. In obtaining this finish without giving undue prominence to the bold natural grain structure in plywood panels, which is sometimes objectionable, a preliminary filler coat of white lead and oil, thinned with turpentine, has been found very effective. This filler coat is applied with a brush in the usual manner, but is wiped off clean before it hardens, leaving the white lead embedded in the pores of the wood. When completely dry, the surface is ready for staining, and since the white lead accepts the stain as quickly or a little more readily than the wood, the natural grain structure of the wood is largely subdued.

Extensive as has been the use of Douglas fir plywood on the Southern Pacific for building interior work, almost as extensive use has been made of this material for concrete forms or form lining. In these latter uses, the most important consideration in many cases has been the economy of form construction and handling, rather than to obtain a smooth surface, because of the frequent desire in building construction to secure a rough textured surface, which cannot be accomplished readily where plywood forms or form lining are employed. However, plywood forms have been used in the building of many foundations and subsurface walls, and not infrequently in superstructure walls as well. The most extensive use that has been made of this material for concrete forms on the Southern Pacific was in connection with the building, jointly with the Santa Fe and the Union Pacific, of the new union passenger station facilities at Los Angeles, Cal., which were completed early in 1939. In this project alone, more than 150,000 sq. ft. of plywood was used for formwork in the construction of foundations, subways and superstructure walls.

The extensive and effective use of plywood by the Southern Pacific is being made under the direction of W. H. Kirkbride, chief engineer, and J. H. Christie, architect.



Section Through the Two-Story Locker Building at West Oakland, Cal., Which Was Lined Throughout With Panels of Plywood

Plywood Wall and Ceiling Facing in Place in the New Locker Building at West Oakland, Cal.

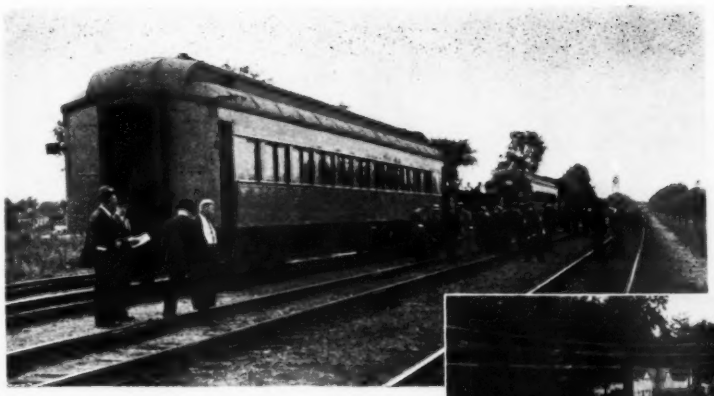
Prompt Action Saves Water Situation

(Continued from page 642)

and thence to and 550 ft. beyond the north end of the initial 1½-in. pipe line, where it was connected into this line. The 1¼-in. hose connections were removed from the 550 ft. of 1½-in. line lapped by the new line and were installed at 80-ft. intervals in the new line. By these means an adequate water supply and pressure were afforded throughout the coach servicing installation.

The emergency having been met, the system well gang went about renewing the broken well casing, replacing it with brass pipe shipped from Memphis, Tenn. This work was completed on August 27, the emergency creek supply having functioned perfectly in the meantime, meeting a second peak demand on August 15, when six troop trains, with a total of 119 coaches and equipment cars, were serviced and moved out in a period of six hours.

The work described was done under the general direction of the superintendent of water service of the Illinois Central, and was carried out entirely by the company's water service forces.



Approximately 150 Members of the Association Took an Inspection Trip Over the Chicago Terminals of the C. M. St. P. & P. on September 12. Left—The Special Train. Below—A Group Examining a Test Section of G.E.O. Track

Roadmasters Hold Near-Record Convention at Chicago

The fifty-fifth annual convention of the Roadmasters' and Maintenance of Way Association was characterized by the largest attendance since 1929, a constructive program and a large exhibit of roadway materials and equipment. The complete report of the convention is presented on the following pages, with the exception of certain addresses, which will be published in later issues

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MEETING for the fifty-fifth time in annual convention in Chicago on September 10-12, the Roadmasters' and Maintenance of Way Association held one of the most successful meetings in its long history, with a near-record attendance and a crowded program which included five addresses, the presentation of six committee reports, one evening session, a banquet, and a trip by special train over the Chicago terminals of the Chicago, Milwaukee, St. Paul & Pacific. It was a meeting designed especially to meet the needs of roadway and track supervisory officers at a time when higher speeds and increased traffic, coupled with the continued demand for the greatest efficiency in carrying out work, are facing them, and, as such, provoked the keenest interest throughout all of its sessions.

The meeting was held in the Hotel Stevens and was supplemented by a large and interesting exhibit of maintenance of way materials and equipment, presented by the Track Supply Association. Altogether, 379 railway officers were in attendance at the various sessions, with a total attendance, including exhibitors, of more than 680, the largest attendance at any convention since 1929.

Reports were presented on Slow Orders—Their Use in the Light of Present-Day Operating Conditions; The Effect of Weight of Rail on Track Maintenance; Methods and Equipment Best Suited for Ditching and Bank Widening; Welding—Its Uses in Track Work; The Maintenance of Gage—Its Importance Under Today's Higher Speeds; and Organization, Equipment and Methods for Handling Snow and Ice in Terminals and on the Line. Addresses were made by C. E. Johnston, chairman, Western Association of Railway Executives, who welcomed the roadmasters to Chicago and solicited their support in opposing the socialistic trend in the country, with government ownership and operation of the railways as a possibility; by A. E. Perlman, engineer maintenance of way of the Denver & Rio Grande Western, who addressed the convention on It's Results That Count; by H. R. Clarke, engineer maintenance of way of the Chicago, Burlington & Quincy, who spoke on The Task of Renewing 50,000,000 Ties a Year; and by C. H. R. Howe, cost engineer of the Chesapeake & Ohio, who discussed The Simplification of Track Work.

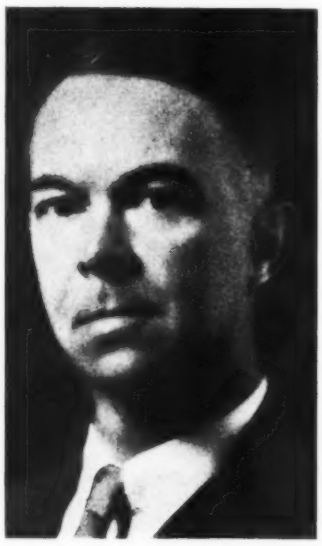
Special features of the meeting included an evening of motion pictures on Tuesday, showing a wide variety of maintenance of way work equip-

ment in operation, which was introduced by a talk by F. H. Rothe, assistant engineer, Pennsylvania, on Making Work Equipment Work, with specific reference to the practices on the Western region of his road; the twenty-sixth annual banquet on Wednesday night, tendered to members of the association and their family by the Track Supply Association, which was attended by 642 persons, an all-time record; and an inspection trip on Thursday by special train over the Chicago terminals of the Chicago, Milwaukee, St. Paul & Pacific, where members were given an opportunity to observe maintenance practices and materials, and a number of tests under way, on this road. Still another feature of the program was a period set aside in the busy program on Tuesday forenoon to honor the memory of C. A. Lichty, secretary of the association, who died on April 18. At this time, words of respect and tribute were spoken by Elmer T. Howson, editor, *Railway Engineering and Maintenance*, Armstrong Chinn, chief engineer of the Alton, both past presidents of the association, and by Lewis Thomas, secretary of the Track Supply Association. All sessions of the convention were presided over by G. L. Sitton, chief engineer maintenance of way and structures of the Eastern lines of the Southern, and president of the association. All of the committee reports, with abstracts of the discussions which followed their presentation, as well as the addresses by Messrs. Johnston and Howe, are presented in this issue. The addresses by Messrs. Perlman, Clarke and Roth will appear in later issues.

New Officers and Subjects

In the election of officers at the closing session of the convention, J. J. Clutz, division engineer of the Pennsylvania, at Indianapolis, Ind., was advanced from first vice-president to president; A. B. Hillman, engineer maintenance of way of the Belt Railway of Chicago, Chicago, was advanced from second vice-president to first vice-president; E. L. Banion, roadmaster, Atchison, Topeka & Santa Fe, Marceline, Mo., was elected second vice-president; F. O. Whiteman, Chicago, who was appointed secretary during the year by the Executive committee to fill the vacancy created by the death of C. A. Lichty, was elected secretary; and E. E. Crowley, roadmaster, Delaware & Hudson, Albany, N. Y., was re-elected treasurer. Three new directors were also elected—C. M. Burpee, managing editor, Railway Engineering and Maintenance Cyclopedia, Chicago; R. L. Fox, roadmaster, Southern, Alexandria, Va.; and P. Chicoine, roadmaster, Canadian Pacific, Vaudreuil, Que.

The report of the secretary showed 789 members of the association in good standing, including 104 new members taken in during the year, while the report of the treasurer showed a substantial balance in the treasury. Chicago was selected as the headquarters for the next convention, and the following subjects were selected for study by committees during the ensuing year: Gravel Ballast—Its Requirements and Preparation; Roadway Machines—Off-Track Versus On-Track Types; Recent Developments in the Renewal of Ties; Present-Day Drainage Requirements—Roadway and Channel; Rail End Wear—Causes and Correction; and Maintenance of Right-of-Way Fences



G. L. Sitton
President

Mr. Sitton was appointed chief engineer maintenance of way and structures of the Eastern Lines of the Southern in December, 1924, after serving that road for 16 years in various capacities including assistant roadmaster and roadmaster. He joined the Association in 1921 and has taken an active interest in its work, serving as committee chairman, director and vice-president prior to his election as president a year ago.

C. E. Johnston Opens Convention

C. E. Johnston, chairman of the Western Association of Railway Executives, welcomed the convention to Chicago, and, speaking from long experience in the engineering and maintenance of way departments of the Kansas City Southern, first discussed the increasing problems of those in charge of roadway and track, and spoke of the important place that the roadmasters and their association hold in the scheme of rail transportation. Then, turning to the broader problems of the railways as a whole, including taxation, subsidized competition, the threat of government ownership, etc., he called upon those present to resist those governmental and other influences which he said are tending toward the socialization of industry, including the railways, and thus, so far as railroad labor is concerned, would "kill the goose that laid the golden egg." Concerning the possibilities of government ownership and operation of the railways, Mr. Johnston said in part, as follows:

Must Protect Private Ownership

"You men hold responsible positions in the official railroad organization. You are a part of the management, and the management is depending upon you to do your part—to help hold together the privately-owned and operated railroad systems of our country. What is, and has been, going on in this country cannot but result in throwing our railroads into ownership and operation by the government. From the standpoint of the present organizations of the railroads, this simply means 'to kill the goose that laid the golden egg.' We simply cannot let such a calamity happen. We must set ourselves for a fight to a finish against it, individually and collectively. Resolve yourselves as a committee of one to do something daily toward improving public sentiment by enlightening those with whom you come in contact regarding the true and correct railroad situation and the necessity for maintaining our railroads under private ownership and operation in the interest of a free people."

Referring to the growing socialistic sentiment in the country, the government's spending policy for "work not performed, for crops not raised and for political purposes otherwise," and "the appalling national debt that continues to mount," Mr. Johnston said: What is going on in front of our very eyes is positively not to the best interests of the rank and file in the long run. They are the ones to suffer if we kill the goose that is laying the golden egg—now providing us all with income. If by taxation and other restrictions, industry in our country, including the railroads, cannot operate at a profit, there is created a condition such as we have been passing through for several

years, the effect of which is still strongly felt. Its continuation cannot be justified from any standpoint of sound reasoning. Railroading is a simple operation of work and thought. It is an essential industry, operated for the common good. I have no time or patience for those in our industry who would, by their acts or sympathies with outside forces, seek to destroy it."

Turning to the subject of organized labor, which he characterized as organized for mutual benefit and in a common interest of labor and management, Mr. Johnston said: "We will all agree that it has a proper place in the picture. It is that operation of labor unions for the benefit of racketeers that creates or foments discord. The octopus thrives when there is public unrest and uncertainty, and a disturbed state of mind among our people. We must never overlook our duty to deal with labor on an absolutely fair and sympathetic basis. We must at all times recognize sincerity of purpose and conscientious effort and extend to our men and their loved ones that measure of human sympathy which will encourage and merit their loyalty and insure to them regular employment under the best possible conditions. This done, management may reasonably expect a fair measure of return in loyalty, in support of its efforts to operate the properties successfully."

In conclusion, and, notwithstanding his expressed concern for the railways under present government policies, Mr. Johnston said: "I think that we have many reasons to feel encouraged over our outlook. I am not one who thinks we will fail in our effort to maintain private ownership and operation of our railroads. I think that we are on the side of Right and will succeed ultimately in our undertaking."

Greetings from A.R.E.A.

H. R. Clarke, vice-president, American Railway Engineering Association, and engineer maintenance of way of the Chicago, Burlington & Quincy, extended greetings to the convention in behalf of his organization, speaking in part, as follows:

"The fact that this is the fifty-fifth convention of this association is a tribute to the vision and the wisdom of the men who founded it. They recognized a need and took practical action to fill it. It is a tribute also to the ability and loyalty of all the men who have carried on during these last 57 years. And the fact that interest is still keen and that the association is more active today than ever before proves clearly that there is work still to be done and problems still to be solved.

"I suspect that many years ago, when the problems were little iron rails, poor ties and no ballast, the men on the firing line thought the going was hard—and we will agree that it was. Certainly the last 10 years have not been easy. With competition subsidized and assisted by public money, much of it contributed by the railroads themselves; with unreasonable and unjustified demands made by many so-called labor leaders; and with constantly rising taxes, all on the one hand, while at the same time affording the best, fastest and most reliable service that the people have ever had, even those of us who have been doing our best to help bring this about wonder how it has been done. And we are still in the thick of the struggle, but I have faith to believe that there are better days ahead, although they may not come until we have passed through even more difficult times.

"In the effort to maintain the fixed properties of the railways to the standards established and required with the funds available, there are three associations closely allied: The American Railway Engineering Association, the American Railway Bridge and Building Association, and your association. Each of these is working in a different field, with a definite and distinct job to do. A man joins one of these groups and works in it because he is interested in the future of the railroad industry

J. J. Clutz
First Vice-President

A. B. Hillman
Second Vice-President

F. O. Whiteman
Secretary

E. E. Crowley
Treasurer

Roadmasters Association

Officers 1939-40

G. L. Sitton, president, chief engineer maintenance of way and structures, Southern, Charlotte, N. C.

J. J. Clutz, first vice-president, division engineer, Penna., Indianapolis, Ind.

A. B. Hillman, second vice-president, engineer maintenance of way, Belt Ry. of Chicago, Chicago.

F. O. Whiteman, secretary, Chicago.

E. E. Crowley, treasurer, roadmaster, D. & H., Albany, N. Y.

Executive Committee

F. B. La Fleur, past president, roadmaster, S. P., Lafayette, La.
(Term Expires September, 1943)

E. J. Brown, district engineer maintenance of way, C. B. & Q., Galesburg, Ill.

H. E. Kirby, assistant engineer, C. & O., Richmond, Va.
(Term Expires September, 1942)

F. J. Liston, assistant superintendent, C. P., Montreal, Que.

R. S. Kniffen, general roadmaster, G. N., Duluth, Minn.
(Term Expires September, 1941)

J. M. Miller, division engineer, W. Md., Cumberland, Md.

E. L. Banion, roadmaster, A. T. & S. F., Marceline, Mo.
(Term Expires September, 1940)

R. L. Sims, assistant division superintendent, C. B. & Q., Wymore, Neb.

W. H. Haggerty, track supervisor, N. Y. N. H. & H., New Rochelle, N. Y.

as a whole, in the progress and development of the particular department to which he is giving his best effort, and in his own advancement in his chosen work. He knows that all three of these interests can be served best by increasing his own knowledge and his ability to deliver the goods. Knowing that one gets in proportion as he gives, you are here today and for the remaining days of this convention to contribute all that you have of knowledge and experience, and in that way secure the greatest possible benefit for yourselves and your respective railways."

President Sitton's Address

In his presidential address, G. L. Sitton viewed with satisfaction the objectives and accomplishments of the association in the past, but called for a most intensive convention in the interest of the members individually and of their respective roads, pointing out that no one knows the extent of the problems which lie ahead. At the outset he said:

"This is the fifty-fifth time, beginning with the year 1883, that this association has met in convention. Truly we are getting to be a venerable organization. The accomplishments of the association in the past have been many and they have been very valuable to the railways. Its objective has been to meet and discuss questions pertaining to maintenance of way, and to raise the standard of work committeed to the charge of its members. I like this objective because it implies that we must never become satisfied with existing standards, but must ever strive to improve them.

"I am sure that those who organized this association and adopted its objective had no idea what drastic changes would take place in railroading in 57 years, but it is evident that they had the foresight to realize that the task of the association would never be finished. I wish to pay tribute here to all those fine men who have been active in building up this association, and, in passing on, have turned over to us the task of carrying on from where they left off. May we ever be guided by their fine example.

"We would all like to look into the future, if only a few years ahead, to see what is coming. But even a far-sighted mind cannot pierce the black clouds of war and destruction and see what is on the other side. In fact, as a nation, we act as if we could not read the handwriting on the wall, even though the letters are as high as box cars. We are in the grip of complacency, which I have come to consider the most dangerous word in our language. But, in spite of the trend of national thought and action, or, if you prefer, the lack of same, I think that those in our group can agree that if we use the present to the best advantage we will be better prepared for the future, no matter what it may hold in store."

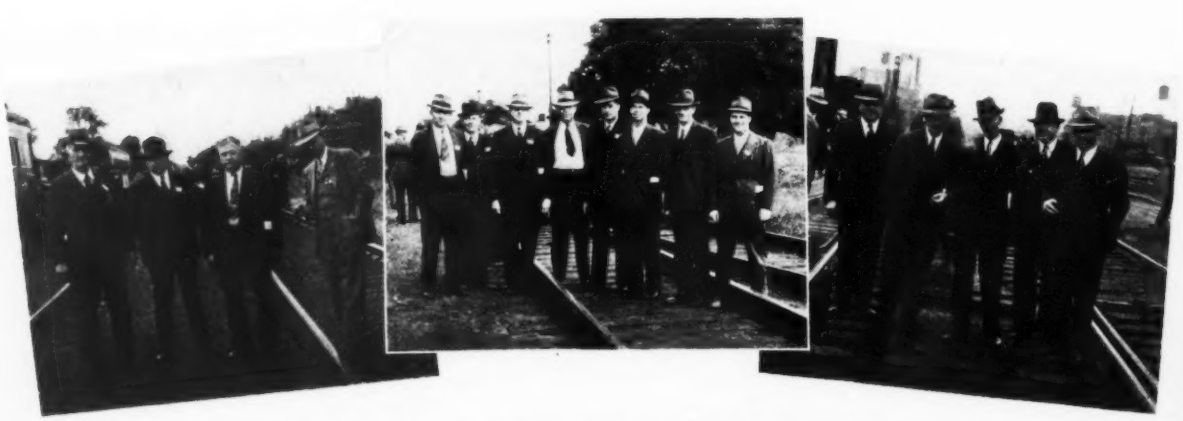
Pointing out that the convention represents a large investment on the part of the railways in the time and expense of assembling so many men, and that railroad managements are entitled to a large return on this investment, Mr. Sitton urged members to fullest participation in the activities of the convention; to study the reports in advance of their presentation; to the greatest freedom of discussion and interchange of ideas and experiences; to an enlargement of their acquaintances among men of like interests and responsibilities; and to careful study of the exhibit of track materials and equipment presented by members of the Track Supply Association. Then, looking beyond the end of the meeting, he pointed out that the value of the convention will not end with its adjournment, but will continue and will be in proportion to the use made of the things learned during its sessions. "The convention will be of little value to us or to our railroads," he said, "unless we do better work and more of it when we get back home. Then too, he continued, in our contacts with our associates back on the line we should discuss the subjects raised here and endeavor to convey to those who could not attend the convention much of what we have learned."

B. & B. Association Represented

A. E. Bechtelheimer, assistant bridge engineer of the Chicago & North Western, and president of the American Railway Bridge and Building Association, brought greetings from that association, in which he spoke of the great value of association work and the close and friendly co-operation that has always existed between the Roadmasters and the Bridge and Building associations, and urged members to still more intensive association work in their own interest and that of their individual roads. He said in part, as follows:

"Probably no two associations have more in common than do the Roadmasters and the Bridge and Building associations. Members of the two groups are closely allied in the work in the office and in the field, and this close cooperation means a great deal in the operation of our railroads.

"Your association, organized in 1883, is a little older than the Bridge and Building Association, which was organized in 1891, and which will soon begin its fiftieth year of activity in the railroad field. I know of no occasion throughout all of these years when there has been anything but the friendliest feeling between these associations, and while each has its distinctive field of service, col-



Many Roads Were Well Represented at the Convention—Left to Right Are Shown Men from the Boston & Maine, the Southern Railway Group, and Representatives from the New York, New Haven & Hartford

lectively, they continue to work as a unit in the service of the railroads of the country. When two bodies of men such as we represent can go along and co-operate with each other for nearly 50 years as we have done, I think we may be pardoned if each feels pride in its achievements.

"Associations like the Roadmasters and the Bridge and Building associations afford opportunity for men of like interests and similar work to get together for the exchange of ideas and for discussion of their common problems. One cannot know it all, at least in these days, for changes are coming so rapidly and in many respects so completely. It is a very alert man, indeed, who can choose the right side of everything new the instant that it is presented. So we must be constantly in close contact with others who are faced with similar problems to insure our keeping on the right track. There is also great inspirational value in joining hands with other men confronted with problems similar to our own."

In his concluding remarks, Mr. Bechtelheimer urged the greatest of loyalty and helpfulness on the part of members toward the officers and directors of their association, especially the secretary; recommended more careful study and use of the reports of the association; called for increased publicity relative to the association's programs and work to the end that still greater benefits will be derived in the interest of the railways; and expressed the hope that each man in attendance at the convention would gain inspiration and encouragement from his participation in the many meetings on the program.

The Simplification of Track Work

By C. H. R. HOWE

Cost Engineer,
Chesapeake & Ohio, Richmond, Va.

THERE is a familiar saying to the effect that "necessity is the mother of invention." I think that you will all agree with me that during the last 15 years on the railways, the necessity for devising new ideas in the use of materials and in handling work has been acute. Ever since the days of the so-called World War, competition with the subsidized carriers on the highways, waterways and airways has constantly increased in intensity. The railways do not exercise control over transportation rates, which fact prevents them from adjusting their income to their expenditures; therefore, expenditures have to be adjusted to income. This has made it imperative that they effect substantial economies if they are to remain in business as private enterprises.

Fifteen years ago, if I, or any one else for that matter, had stated to you that it would be possible to reduce by nearly one-half the amount of work to be done, and still maintain good-riding track, you would have been skeptical, to say the least. Yet, in less than 15 years, many of the railways in the United States and Canada have actually reduced their track labor more than 40 per cent, and in the meantime have improved track conditions. If we are asked to explain this seeming paradox, the answer is not hard to find, for it is contained in the topic of this address—"Simplification of Track Work."

Three Steps Necessary

Now just what is meant by this expression? To the trackman it should mean the elimination of non-essentials and lost motion, and the taking advantage of improvements in equipment and materials, and better organization. In short, reduce the effort required to perform a given job.

In the solution of any problem of work simplification there are three steps that must be taken. First—we must have a thorough understanding of the details included in the operation in question, and a definite knowledge of the costs involved. Second—having secured this necessary information, we must analyze the defects revealed by the study, and proceed with plans for corrective measures. Third—and perhaps the most difficult step of all, we must establish the new routine. To accomplish this third step, it is necessary not alone to issue instructions as to what is required, but to train our subordinates in such a way as to insure that instructions are carried out.

Let us examine each of the three essential steps enumerated in some detail. First, in securing information, it is not always necessary to have actual cost figures; in fact, in some cases it is practically impossible to obtain them. I doubt if any of us would question the superior value of machine-adzed ties or mechanically-tamped track. However, the immediate savings in either case are indeterminate, and are so interwoven with other items of track work that the benefits derived from them become a part of the general result.

This, of course, does not apply to direct comparisons of organizations doing similar work at a given time, such as the gang set-up for rail laying or for surfacing track. Nor does it apply to comparisons of equipment used, in such work. Here, we must have definite figures.

While in many instances we may rely upon our good judgment, it is not always safe to rely upon the opinions that we form unless they are backed by actual figures. I recall having witnessed, in company with other railroad men, the demonstration of a certain track-work machine. The purpose of that machine was the gradual application of an enormous pressure, which required a very slow motion. After accomplishing its purpose, the machine proceeded to complete what might be called its idling motion, in what seemed to me to be a very lazy manner. This apparent loss of time was commented upon by many of those present. But, to make sure in this regard, I timed the complete operation of the machine, and found to my surprise that the work was being done four to five times as fast as it could be done by hand.

Cost Analysis Important

On the other hand, the use of machines, in themselves, on a job does not always mean saving money; sometimes it is more costly. A few years ago when it was the practice on our road to secure tie plates to the ties by means of lag screws, we found it economical in out-of-face work to employ power wrenches. As a result of study and experience we were able to reduce the cost of installing the fastenings to a reasonable figure. Subsequently, we found that when the section forces came to make individual tie renewals, the cost of removing and replacing lag screws by hand was more than double the cost of machine work. The natural thought, therefore, was, why not use the machines? This it was proposed to do by going over a district with machines, removing the lag screws from all of the spotted ties, and then, after the section forces had made the tie replacements, to send the

machines back over the territory to insert the screws.

When this proposal was analyzed in detail it became apparent that it would be the wrong thing to do, for with average renewals of less than 100 ties per mile, the time spent in traveling from tie to tie with the machines was much greater than the time required when hand wrenching. In fact, it would have doubled the cost of installing the lag screws, because the section force on the ground required no additional travel time for applying the lag screws.

Study Performance

In many cases where the question of the purchase or use of machines is involved, a record of previous performance costs, either by manual labor or with other types of machines, is invaluable. The method of ascertaining and recording costs will depend largely upon the particular objective in view, varying from simple time studies to complete details of all operations over a period of years. A number of railways have made good use of the moving picture camera in studying the effects of machines and special gang organizations on performance. This method has the advantage that the films may be run over and over again, making it possible to note each time a different operation and its relation to concurrent operations. Thus, the key operation which controls the rate of progress of the work as a whole can be determined, and the number of men and machines that are required for other parts of the job in line with this key rate can be established.

I had the privilege of presenting to this association, at your convention in 1927, a report on the Collection and Use of Cost Data by Supervisory Officers. This report included a description of the cost-keeping system that had been established on the Chesapeake & Ohio for recording in detail a record of all track work performed. That system is still in effect on our road. The data collected during the last 15 years have been of great value to us when considering the purchase of the many new machines that have been brought out during this period, and also in adapting our various organizations to the use of those machines that have been purchased.

Analysis Necessary

The second step in work simplification, that of analysis, is an extensive subject, ranging all the way from simple arbitrary decisions, such as whether we will mow the right-of-way once or twice a year, to the highly complex studies required in determining the proper organization for a fully mechanized track-surfacing or rail-laying gang. Within the confines of these remarks I can hardly do more than mention the high spots of our track operations. I would like, however, to give you a single illustration of how the results of a specific analysis can be used to advantage. In doing this, I quote from a previous address:

"Those of us who have had direct connection with laying rail know that the conditions for laying vary, not only on different parts of a railway, but also from day to day, even on the same track. While local officers and their subordinates are in the best position to understand local requirements, they must also accept responsibility for the results obtained. However, it is asking too much of a general foreman in charge of one of these large mechanized gangs to make spot decisions as to the lineup of his men and machinery without experiencing considerable lost motion. To minimize such losses, we have found that it is helpful to provide our men with information indicating what results are probable under any set of given conditions."

In the case of rail-laying, for example, the information referred to, which is determined from past experience and records, is shown graphically on a colored chart. This chart gives the foreman an approximate idea of how many rails he can expect to lay in a given time with the force available, employing any one of several methods of operation, and at what cost for a given set of conditions.

Training Subordinates

The establishing of a new routine in track work is not simply a matter of issuing instructions, for success cannot be achieved without the aid of competent direction and supervision. Herein lies the importance of care in the training of our subordinates. None of us relish the prospect of old age and retirement, but we all recognize the inevitable fact that some day we will reach the end of the line, and must pass our responsibilities on to others. The extent to which they will be successful may depend largely on the training that they have received from us.

At the time the cost system was established on the C. & O., the subject of the replacements to be expected over a period of years was given careful study. It was realized that many of our future maintenance of way and transportation officers would have their origin in the ranks of our young engineers, section men, or possibly clerical forces, depending on the individual's ability. The problem was to determine what method would serve best to prepare them for future responsibility. The conclusion was reached that a system of training that would give them a common basic knowledge of the relative values of various track work operations would be most effective in securing uniformity of purpose in handling work. It was concluded further that the placing of these men under the immediate direction of experienced supervisory officers would be beneficial to both. The trainee would have the opportunity of learning the methods of management employed by his superior, who, in turn, would receive valuable work performance information heretofore unavailable to him. The system as outlined was put in effect and has continued to operate ever since. We consider that for us the question of replacements in our supervisory forces has been solved.

The Future

Earlier in this paper I called your attention to the notable reductions in the cost of track maintenance that the railways have effected during the last 15 years. At the present time revenues are increasing and we may reasonably expect to receive larger allotments of material and labor. Just how long this favorable situation will remain is anybody's guess. There is

Success in Carrying Out Maintenance of Way Work Cannot Be Fully Achieved Without Competent Direction and Supervision

no doubt whatever that this country, with the world at large, is facing an economic crisis. What the outcome will be for the railways no one can predict. What demands we will have to meet, only the future can reveal. We should, however, while we still have time, consider what steps we can each take in the further simplification of our work, so that we will be prepared, if in the future we are called upon to meet even more drastic conditions than those that have prevailed in the past.

The greatness of this country was created not alone by its vast natural resources, but also by the industry and perseverance of its people. The rapid development of our resources has been made possible in large measure by the fact that our predecessors, through their ingenuity and progressiveness, produced the finest system of railways in the world. We may expect to face some difficult problems in the near future, but unless I am greatly mistaken in the caliber of present railroaders, there will be no let down in the traditional American supremacy in the field of track maintenance.

Handling Snow and Ice—Organization, Equipment and Methods

Report of Committee

P. Chicoine
Chairman

ALTHOUGH the winters vary in the intensity and duration of their snowfalls and their low temperatures in different latitudes, snow fighting for most of us, irrespective of where we live, is a difficult task, fraught with hardship, especially during and immediately after storms, when the efficiency of our forces is greatly reduced at times because of the extremely low temperatures. It is the purpose of your committee to set forth the measures that may be taken to cope with the snow and ice conditions that prevail over the Coastal and Great Lakes regions when harassed with heavy blankets of wet snow, driving sleet storms, and rain; those that prevail over the areas of mixed farming, and the wind-swept prairies, where fine, granular snow is whipped along the ground, forming drifts along the tracks and filling cuts in ways that create serious handicaps to railway operations; and finally those that prevail in the wooded sections and at the higher elevations in mountainous areas where, although perhaps comparatively free from the effects of high winds, the removal of the natural snowfall is a most expensive item and snow slides are a cause of delay and interruption to traffic.

The handling of snow may be divided between the problems encountered—(1) on the line and (2) in the clearing of yards, station layouts, large interlocking plants and other facilities about terminals. Both of these have a common basis of organization in that the forces must know their stations and their equipment and must be drilled and educated in their assignments and work. While direction may be invested in the division engineer or the superintendent, the actual preparations are in the main delegated to the roadmaster or supervisor upon whose shoulders the ultimate success of the winter operations rests.

The efficient handling of snow and ice in the terminal and on the line requires a detailed plan of organization, involving not only a thorough knowledge of the physical characteristics of the terrain, the effects of varying winds and the method of controlling their action, and the results of varying and sudden changes in temperature running from one extreme to the other, but also a pooling of the resources of the operating and the mechanical as well as the maintenance of way departments, so that each understands the part that it is to play and is in a position to cooperate when required. Many storms come with little warning and when they arrive traffic must be kept moving at all costs.

The first days of spring, almost before the experiences of the previous winter are out of mind, are none too early to begin planning for the next year. Every unit of mechanical equipment should be examined to ensure that such repairs are made as may be necessary to put it in perfect condition. If all of the heavy snow fighting equipment is reconditioned during the spring and early summer, there is no possibility of a congestion of work in the shops later in the year interfering with the giving of proper attention to the equipment and having it in readiness in the fall. Furthermore, if this work is done while defects are still well in mind and it is stored clean, fully greased and oiled, a higher class of repair work and a higher standard of general maintenance of the snow fighting equipment as a whole will result.

Fall Check-up

With heavy snow fighting equipment in good condition by the middle of the summer, little further thought need be given to winter preparation until about the first of September. Then each track supervisor or roadmaster should make a personal check of the snow fighting equipment and supplies in the hands of each of his foremen to insure that, at the proper time, they will have an adequate number of serviceable brooms, shovels and picks on hand and a sufficient supply of salt, sand, snow-burning oils, etc., to meet all requirements. At the time that these supplies are investigated, the foremen should be instructed to give early attention to drainage conditions at culverts, switches, water columns and all other points where a quick run-off is essential to proper and safe operation through the winter.

On line divisions, each supervisor or roadmaster should discuss winter preparations and snow fighting methods with his foremen individually. In these personal talks, the snow fighting plan, as it pertains to their territories, should be reviewed thoroughly not alone to adjust the assignment of men where desirable in the light of previous experience, but also to be sure that the foremen understand thoroughly their responsibili-

ties and those of their men under storm conditions. This occasion should also be taken advantage of to review with the foremen instructions for the handling of the extra snow fighting forces which may be assigned to them, the keeping of special time rolls, and the arrangements for housing and feeding different groups of men where necessary. As a result of such a preliminary check-up and talk, there should be no misunderstanding as to the supply and force requirements of each foreman; what is expected of him in preparing for winter conditions and his duties and those of his men during actual storms.

In terminal areas where traffic is more dense, meetings are sometimes held in the local offices where the general plan of operation is drafted and discussed. At such meetings the operations of the previous winter may well be reviewed and changes in methods or assignments considered. All assignments should then be made so that every man will know just where to report. Each man should be notified of his assignment and, in addition to the general and detailed instructions given to all foremen, any special instructions that may be necessary should be imparted. So far as possible, these assignments should be repeated from year to year so that men will be in charge of points with which they are fully familiar and thus be able to draw on their previous experiences. Their telephone numbers and street addresses should be posted in towers and other offices so that they may be obtained with minimum delay and effort when required.

In addition, a winter bulletin should be issued to all concerned, covering the winter services, and enumerating the various units of equipment available, their locations and assignments. Included therein should be a list of the names and addresses of the operators and their substitutes, also information as to the ways to obtain additional tools, materials, etc., as may become necessary in the prosecution of the work, so that all may act without hesitation when necessity demands.

Preparatory Work

About the middle of October, special stocks of brooms, shovels, picks and other snow tools and materials should be distributed to strategic points where their issuance will be under control when they are required for casual labor as it becomes necessary to add to the regular forces at the commencement of and during the progress of a storm. At the same time when the emergency stock of tools and supplies is being assembled, switches should be prepared for the reception of heaters where possible. This consists in the main of cleaning out the cribs and removing the ballast to about the bottom of the ties in order to give ample room for the flame to spread under and around the rail; sheet metal in many cases may be applied to the sides of the ties adjacent to the heaters as a precaution against scorching the wood if the wind should blow the flame against the ties. Normally 12 heaters are required for a switch, 6 under each point, although in some cases this may be reduced to 8 if the switch is so located that it is protected from the wind. Forty are used on

Switch Heaters of Various Types Have Greatly Simplified the Winter Problems of Maintenance Men at Large Terminals

double slip switches, the number increasing to 50 where movable point frogs exist. Other switch-heating and snow-melting equipment such as electric switch heaters, snow melting cans, torches, steam coils and compressed air lines should be overhauled and installed where possible, and given thorough tests to insure that they are in good working order.

In suburban territory where interlocking plants are numerous, it is essential that they be kept open. In recent years the burners of gas heaters have been improved considerably and good results have been obtained, particularly where natural gas is available. As there is a certain amount of moisture in artificial gas, it is essential that this be removed by drip pots; otherwise the gas lines will freeze in extremely low temperatures. It is also highly important that the gas supply be sufficient in size and that the gas pressure be maintained at a proper level, pressure boosters being installed to insure this. On electrified lines or in areas where electricity may be obtained at low rates, electric snow melters are commonly used. The use of steam heat for melting snow has proved so successful that it is being employed in many of the larger metropolitan areas. The system, which is simple and effective, consists of steam mains supplying steam at about 70-lb. pressure to coils extended transversely beneath switch points, movable frog points and interlocking devices. Traps of improved designs have done much to increase the efficiency of this method. Where compressed air is available from shop lines or where portable air compressors are available, air tampers equipped with specially-pointed tools and hose are used successfully in chipping out ice and blowing snow out of intricate switch work and other turnouts. Gasoline-driven and other similar tampers are also utilized in the removal of ice from switches and tracks and at stand pipes.

Some roads have employed engine-mounted snow blowers for the removal of snow from switch layouts. These blowers consist of a horizontal pipe placed on the front end of the engine crosswise of the track, with a series of holes on its under side from which steam is blown down onto the track as the engine moves slowly forward. This arrangement has been used effectively under certain conditions, however, it can only be used to advantage when the temperature is not low enough to cause melted snow to freeze immediately. In some instances, engines are equipped with air lines under their foot boards in place of steam pipes. The advantage claimed in this arrangement is that no water is left from melting snow.

Heavier Snow-Fighting Units

The heavier working units, including snow plows, rotary plows, flangers, spreaders, weed burners, tractors equipped with either bulldozers or front end loaders, snow loaders and either track mounted or off-track-type cranes equipped with snow buckets, platform sweepers, and air compressors should be moved to their assigned locations and operators assigned to them who are qualified not only to handle them but also to make light repairs. In programs so prepared, each important unit of equipment is so assigned that every vulnerable point may be protected as adequately as possible against the most severe conditions anticipated.

Most roads in snow territory must rely upon emergency labor to meet the demands of unusually heavy or prolonged storms and no stone should be left unturned to insure that an adequate supply of emergency labor, suitably clothed and sufficiently rugged, may be made available on short notice. In outlying territories supervisors and foremen may make advance arrangements with men whom they know are available and reliable for snow removal work so that these men will assemble almost automatically for possible employment in a storm.

In the larger cities and terminal areas, emergency labor may be secured through established employment agencies that are familiar with the requirements and that can furnish the desired number of men on minimum notice. When storms break, these arrangements leave supervisory officers unencumbered with the problems of rounding up additional men, and of seeing that they are clothed suitably, and facing only the responsibility of fitting them into experienced snow-fighting organizations and seeing that they do effective work.

In the prairie and agricultural areas, the snowfall is not usually of sufficient depth to hamper operations seriously, if the snow is not gathered up by the wind and deposited on the track. The first care, therefore, should be to prevent this by causing the snow to deposit in drifts before it reaches the track. To accomplish this, various types of snow fences have been found useful. Two of the more commonly used are (a) one constructed of one inch unedged boards and (b) one built like a picket fence but built in short rolls. Extensive experiments have also been made in growing trees to serve as wind breaks or permanent fences, those in the agricultural areas having proved highly successful while those in the prairie belts have not met with the same results. Any means whereby wind breaks intercept and retard the velocity of the wind, and cause it to drop the snow it carries short of the point it protects, gives satisfactory results.

Where the right-of-way is too narrow for the erection of permanent fences on railway property, temporary or portable fences may be placed on private lands.

Crossing planks should be removed from all farm crossings that are not used during winter months to permit uninterrupted operation of snow plows and flangers. Where, for various reasons, this is impossible, standard snow plow signs should be erected, as is done at other crossings and obstructions, where the point must be lifted and the wings of plows closed. The ends of culverts should be marked so that they can be found readily and cleared of snow before the spring thaws. Shims and other materials piled on the right-of-way should also be so marked that they may be found readily, even though buried in snow. Brooms, shovels and graters should be hung at each switch-stand on outlying territories to enable train crews to sweep the snow from the points of hand-thrown switches.

Protection of Flangeways

A very necessary measure in these days of heavy highway travel is the protection of flangeways at road crossings. Unless guarded against, these pack solid with ice and snow and are likely to cause derailments. Where possible, they should be kept salted and cleaned by crossing watchmen or regular track forces. However, in the larger metropolitan areas it has been found advisable to move flying squadrons of men from crossing to crossing in motor trucks to clean out the flangeways and sand icy road surfaces.

The equipment used for the removal of snow from the tracks consists of engine and pilot plows, push plows, wing plows, spreader plows, machine plows, flangers, ice cutters and rotary plows. The latter are used only to remove snow slides (or an accumulation of snow which may have collected on the track, and during the operation of spreader). The wing plow is used generally for clearing main and side tracks and for the removal of small snow slides and drifts. The spreader is used considerably in conjunction with the wing plow to clear sidings and yards and other extensive snow accumulations.

When the natural snow fall has reached a sufficient depth to threaten to impede the free movement of trains, snow-plow service is put into operation. The salient feature of the wing plow is its movable nose plate which cuts the snow from between the rails, can be adjusted to cut a depth of 4-in. below the top of the rail, and when in its raised position clears the top of the rail to standard clearance. The two wings fit close to the sides of the body of the plow when not in use and can be extended to an angle of 45 deg. when in service. These wings level off the snow to a height slightly above the top of rail for a distance of 5½ ft. from each rail. They also throw some of the snow beyond the end of the wing, the proportion of the snow thus thrown and the distance it is thrown, depending on the speed with which the plow is moved along the track. Both wings and the nose are operated by air and can be held at any position within the maximum range of their operation.

The spreader has become almost indispensable for handling heavy snow falls in yards, in sidings and on double track, and various ice and snow conditions. Its main features are a movable nose casting which cuts slightly below the top of rail when in the lowered position and the teeth with which it is equipped in most territories for removing ice from between the rails. The two wings, when extended, reach 16 ft. or more from the rails and, as in the case of the wing plow, all movements are generally air-operated. In sidings and yards it is usual to spread the snow in one direction, all snow dug up by the nose and thrown out being collected by the spreader wing and deposited in a ridge well beyond the tracks.

Flangers are equipped with air-operated scoops which can be lowered sufficiently to remove the snow between the rails and eject it to the side of the track. Flangers are used in conjunction with the plow and spreaders to improve the flangeway in territory of sharp curvature and in places which prevent the nose of the wing plow being lowered. There are scoops for each direction, which allows flangeways to be cleared in either direction without turning the flanger. Flangers may be used as a separate unit, attached to the rear of freight and other trains to improve the flangeways in case of unusual storms in territory not generally affected and where snow plows are not usually operated, or where the fall, while heavy enough to create heavy flangeways, is not of sufficient intensity to warrant the despatch of a train crew and wing plow. Flanger cutters, separated on the scoop of the flanger, can be arranged to avoid train-control magnets and guard rails between the track rails.

On some roads flanger cars are fitted with rotary brushes. These have been found effective for clearing the space between the track and the third rail on third rail electrified lines. On such lines, flanger cars are fitted with shoes to clear the third rail. These roads also employ chloride cars which throw a hot solution on the third rail to free it of ice.

The work of the snow-service train with its various units of equipment is performed under the direction of an efficient foreman. The train conductor is responsible for movements on the main tracks and the roadmaster, of course, is in general charge of the work.

Generally, two men are assigned to each snow plow. These men should

have a thorough knowledge of the divisions over which they work; they must, of necessity, be familiar with operating rules and should be required to pass examinations similar to that required of train conductors.

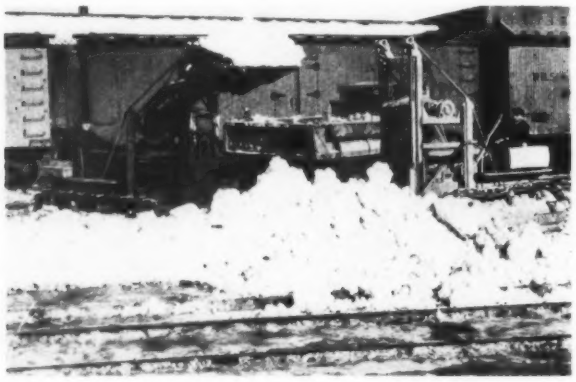
A common mistake of many plow crews is to pull in the wings and raise the flexible points or flangers in a cut when there is a liability of the train being stalled, thinking that by so doing they can get through. If the train should become stalled with the wings closed and the flangers raised, it will be necessary to dig the plow and engine out while if they should succeed in getting through by moving slowly with wings closed, they will leave a very bad track and one over which it is not safe to back a plow in order to go through the cut a second time. However, if the wings are kept open and the flangers down until the train stalls, the engine has a good flange and can generally back out unaided and make as many runs as necessary to clear the cut properly.

Another fault among some plow foremen is the practice of maintaining continuous full pressure on the wings when in operating position. Prudent operators run with the valves lapped where necessary; that is, after having thrown the wings out to full-out position, the pressure is released slightly through the lapping of the valve, which will permit the wings to close sufficiently if they should come in contact with some concealed obstacle rather than being held rigidly, which causes the plow wing to spring forcibly, breaking safety chains, releasing the pistons from wing-out cylinders and possibly derailing the plow.

Bucking side hill drifts constitutes a problem of considerable anxiety to plow foremen. It has been found through experience that the use of two powerful engines coupled together is not the best practice, as it has led to derailments. A preferable procedure is the use of a single powerful engine, with a follow-up engine to pull the equipment out of the drift when it stalls in a cut. When the drifts are higher than the top of the wing, they should be broken down to minimize side pressure.

Snow Slides

Snow slides generally occur during a period of mild weather following a heavy snow storm. These may vary from 50 to 500 ft. in length and from 5 to 40 ft. or more in depth, and sometimes bring down considerable timber and rock. Small slides are cleared by the push plow. If the slide is small enough, the plow is run into it at high speed, with the point down and wings extended. It is not advisable, however, to enter a slide too fast unless there is a good chance of breaking completely through it. Some of the larger snow slides are perennial, others are spasmodic; the former have well-defined paths down which they travel from the mountain tops to the valleys below. In such cases, snow sheds are built as protective measures.



Tractors Can Be Adapted for a Wide Variety of Snow-Removal Work at Stations and Terminals

Handling the Plow

Rotary plows are handled in an entirely different manner from push and wing plows. Instead of depending upon speed to get through the drifts, the rotary plow is pushed against the drift or slide at a speed of from 6 to 8 miles per hour, and the cutting wheel, revolving at approximately 400 r.p.m., is fed into the drift instead of bucking it. The engineman on the locomotive holds the rotary against the face of the drift or slide until he hears the exhaust tending to slow up, whereupon he backs out 3 or 4 ft. and again pushes against the face, repeating this process until signaled to back out of the slide by the foreman in charge or the rotary engineman.

During these intervals the track is examined carefully to see that no rails have been misplaced or broken. The sides of the cuts should be trimmed off by shovels or mattocks to provide extra clearance. The flangeways should be picked out to prevent derailments and if the face of the snow bank is higher than the hood of the rotary it should be broken down.

The despatch of these machines is generally governed by the recommendation of the roadmaster, who, in conjunction with information received from the track forces, the engine crews and his own personal observation, keeps in close contact with the operating officers, working out a plan whereby the snow fighting equipment may be operated over the division at the most advantageous times.

Terminals a Special Problem

While major difficulties are often encountered out on the line in heavy snow territory, it is in the terminals, with their intricate track and switch layouts and their numerous interlockings, that heavy falls of snow create the most difficult problems for snow fighting forces. These problems are not confined to the duration of the storm, since in many terminals the disposal of the snow after the storm is over is a matter of urgent necessity which largely increases the cost and has often taxed the ingenuity of the maintenance officers in devising means to accomplish this disposal in a reasonable time.

In many places, reliance has been placed almost wholly on manual methods, using snow brooms, shovels and scrapers for keeping the switches clear and augmenting the regular forces by such casual labor as is deemed necessary. Contrasted with these manual methods which were employed almost universally up to a few years ago and are still common on many roads, maintenance of way men now have at their command a variety of snow melting and other snow fighting devices which have proved their effectiveness under the most adverse conditions of heavy snow fall, high wind and low temperatures. And it has been amply demonstrated that the devices which melt the snow at switches and interlockings as it falls make it practicable to reduce and in many cases to eliminate the manual effort required to keep switches clear, and incidentally the amount of casual labor that has heretofore been necessary. Likewise, effective equipment is now available to remove economically the accumulation of snow around team tracks and from driveways.

Fully as impressive as the effectiveness of these snow melting installa-

tions are the economies that have been realized through the use of these devices. To these readily-determined amounts, there may also be added an equal or probably larger indirect but indeterminate saving in transportation costs through the elimination of train delays and uninterrupted traffic.

Melters can be classified as portable, semi-portable and fixed. The first type comprises such equipment as can be carried by hand or moved under its own power from point to point as needed.

The second type is represented by those devices which consist of a fuel reservoir and combustion chamber. They are placed in position at the switches upon the approach of the storm and are used in the same way as fixed snow melters, but are removed when the storm is over. The fixed type embraces those units which are installed at or applied to the switches, at the beginning of the winter and remain in this fixed position until all danger of snow is over in the following spring. Heat for these types may be supplied by means of electricity, oil, gas, steam, etc. To these mechanical devices may be added a fourth or chemical type which comprises snow melting salts having low freezing points when in solution and which heat while going into solution, thus adding to their power to melt snow.

Sleet Storms

One of the most difficult kinds of storms to fight is the freezing sleet storm, particularly if the rain turns to freezing snow. In such storms the snow has a tendency to arch and freeze over nearly every kind of heating device. To overcome such conditions it has been found advantageous to make use of snow melting oils burned from approved cans. The flame from this oil vaporizes the snow and ice and proves quite effective in sleet storms. Its use is particularly valuable at power interlocking plants as it permits clean contact at switch points. These oils have proved to be of more or less universal use and have proved valuable as a standby aid for use in the event of the failure of gas or electric installations. The use and storage of these oils must be governed by exact instructions as they are explosive under some conditions. Properly used, however, with even ordinary care, they have proved to be safe in the hands of the most unskilled labor.

Owing to the variety of types of snow melting equipment in service on the various railways, it is not practicable to determine the relative economy of the several types. It is sufficient to say, however, that since their installation, casual labor has been greatly reduced and as a result of the successful operation of the fixed heaters and the minimum amount of attendance and care required, the installation of these types of heaters are being greatly extended.

With the cessation of the storm, the work of the maintenance of way forces is only momentarily relieved, if the snowfall has been heavy or there has been much drifting. The accumulations of snow around the interlockers in yards, on driveways, in team yards and elsewhere in the terminal area must be removed. Again during recent years equipment has become available through the use of which such accumulations can be removed quickly and economically.

Modern plows can be used effectively to clear the snow from main line tracks. In yards the snow can

Power Tie Tampers Are Used Effectively at Many Points to Break Up Ice for Removal

be removed from and between the tracks by the use of the more modern type spreader, ridging it up on one track taken out of service temporarily, thus making possible a quick recovery from the severest conditions.

Crawler-mounted and industrial tractors can be adapted for clearing driveways around stations, freight sheds, team yards, shops and elsewhere in the terminal area, by the addition of special attachments such as push plows, rotary brooms or loaders, all of which are readily available. Also specially-built snow sleds with large capacity boxes hauled by tractors are very economical.

In many cases it is practicable to pile the snow in out-of-the-way places where it does not interfere with the use of the yard facilities, and is allowed to melt away. Where this is not practicable, the snow may be loaded either by portable snow loaders operating under their own power or by industrial cranes equipped with clamshells or snow buckets into trucks which, if not otherwise available, may be obtained from cartage contractors at a reasonable rental. The snow may be disposed of through dumping into the sewers or in streams or through the use of privately maintained melting vats. These vats have been found to be of great advantage in cramped areas in terminal yards, where proper drainage is available. They are built to various dimensions in accordance with the volume of snow to be handled and are usually in close proximity to stationary heating plants. Although it has been found advantageous, where steam heating facilities are not available, to use a locomotive temporarily to supply the steam required. At enginehouses, smaller steam vats have been constructed in the turntable pits. Snow is hauled to the larger vats by motor trucks rented from contracting firms as required, while at the enginehouses the snow is handled to the pits with scrapers. Snow trains consisting generally of a number of side dump ballast cars with ledgerwoods or rapid unloaders are used effectively in some yards for the removal of snow.

Platforms

Station platforms may be cleared by the use of revolving brooms mounted on small gasoline-driven tractors which, when not actually employed in clearing snow, may be used in handling mail, express or baggage, etc. With such arrangements, platforms are cleared more cheaply, quicker, and much better than by hand at a cost of about one-third. Special attention should be given to the spreading of sand, sawdust, salt, or a salt and sand mixture, to eliminate slippery conditions which arise around station driveways, and platforms and along ladder leads in yards. Their early and continuous use has done much to reduce personal injury and loss of time to both patrons and employees.

Most of the equipment enumerated is already available on the railways and with a little resourcefulness maintenance officers can adapt it for this work, thus shortening the interval of recovery as well as effecting attractive savings. While casual labor may be reduced to a minimum in the larger centers through the use of labor-saving equipment and of other materials and accessories that are available, this equipment is unwarranted at outlying points, and at such places casual labor must still be used almost exclusively.

In conclusion the Committee emphasizes that, in coping with snow storms, nothing is more valuable than preparedness—an organization properly established, with an adequate complement of supplies, properly distributed, with complete knowledge of the territory and machinery under its charge, operating to a pre-determined schedule wherein those assigned to supervisory positions are available when required to make decisions and to handle emergencies as they arise. Good judgment must, of course, be used in determining when the snow fighting organization should be pressed into operation.

Experience has taught that the cheapest and most effective way to cope with storms is to keep abreast of the snowfall, which may not be possible if initial action is delayed unduly.

Committee—P. Chicoine (chairman), rdm., C. P. Vaudreuil, Que.; Guy Palmer (vice-chairman), engr. main., B. & O. C. T., Chicago; W. Allan, rdm., C. P., Montreal, Que.; Marcel Belec, gen'l for., C. P., Montreal, Que.; G. R. Chambers, devel. dept., C. I. Ltd., Montreal, Que.; L. J. Gilmore, rdm., G. N., Superior, Wis.; J. R. Hamilton. div. engr., D. S. S. & A., Marquette, Mich.; W. E. Heimerdinger, supt., C. R. I. & P., El Reno, Okla.; R. S. Kniffen, gen'l rdm., G. N., Duluth, Minn.; F. J. Liston, rdm., C. P., Montreal, Que.; R. W. Lucas, rdm., C. R. I. & P., Manley, Ia.; F. H. Masters, ch. engr., E. J. & E., Joliet, Ill.; P. F. Muller, rdm., C. & W. I., Chicago; H. H. Notley, rdm., S. P., Colfax, Cal.; W. C. Peters, rdm., A. T. & S. F., Newton, Kan.; W. J. Schram, supvr., D. & H., Saratoga, N. Y.; G. G. Smart, gen'l rdm., G. N., Seattle, Wash.; J. C. Stotler, rdm., N. P., Lester, Wash.; W. F. Wiggins, rdm., B. & A., Houlton, Me.

Discussion

The discussion turned to the use of high-pressure steam for blowing snow out of switches. W. A. Moberly (C.M.St.P.& P.) stated that locomotives equipped for this service have proved quite effective at temperatures well above zero, but that at or below zero temperatures this method is far from satisfactory owing to the formation of ice from the melting snow and the condensing steam. The value of keeping a complete log of what has happened during a storm was emphasized, so that weak places in the organization or methods can be corrected in advance of the next storm.

C. C. Pelley (I.C.) described the methods of fighting snow followed in the Chicago terminal of the Illinois Central, and told in some detail of the use of weed burners for melting snow. He reported some difficulty with respect to the disposal of snow water where this equipment was used during heavy storms. E. J. Brown (C.B.& Q.) had not experienced this difficulty, and had found the burners quite satisfactory, especially for cleaning up after storms. A. Chinn (Alton) spoke about the necessity for drainage and cited an experience where weed burners had been used, in which, after a 6-in. snowfall, it was necessary to pick out 3 in. of ice. It was brought out that, while quite effective in snow, weed burners are ineffective for clearing ice.

J. J. Clutz (Penna.) recommended the use of tie tamping tools with special bits to pick out ice. He also emphasized the point raised in the report with respect to the protection of switch ties where oil-burning switch heaters are employed, mentioning that asbestos sheets provide excellent protection against the flame of the heaters. Mr. Brown called attention to the accumulations of ice that form around switches equipped with snow melters during heavy storms at low temperature. Mr. Chicoine suggested the use of hydrocarbon snow-melting equipment to combat the ice.

Maintenance of Gage For Today's Higher Speeds

Report of Committee

CORRECT gage is essential to well-maintained track at any speed. Under today's higher speeds it is even more important than in the past for the same reason that good surface and good alinement are more important.

Irregularity in gage, surface or alinement will cause a certain amount of shock to be transmitted to moving equipment and to track. The effect of the shock which is transmitted to the track is to increase the irregularity in gage, causing irregularities in surface and alinement. The magnitude of this shock varies directly with the square of the speed of the train. It is over twice as great for a train going 85 miles an hour than for one going 60 miles an hour, and is four times as great at a speed of 100 miles per hour as it is at 50 miles per hour.

The riding quality of track depends on the three "R's" of track maintenance—gage, line and surface. A stretch of track may be in good surface and good line but if it is out of gage it will ride poorly.

Causes of irregular gage may be enumerated as follows:

W. E. Heimerdinger
Chairman

1. Poor workmanship when the rail is laid.
2. Trains operating at too high rates of speed before tie plates have seated at the time the rail is laid.
3. The thrust of the wheels loosening the spikes and enlarging the spike holes sufficiently to allow the rail to be forced out of position.
4. Track being out of line.
5. Poor line and surface.
6. Rail wear, particularly on the high sides of curves.
7. Relation of the running surface of the rail to the wheel treads.
8. Condition of ties.
9. Excessive lateral play in equipment, especially the driving wheels of locomotives.
10. Creeping of rail, causing slewed ties.
11. Use of gages which are not in true gage.

If good workmanship is not obtained at the time that rail is laid, particularly in securing accurate gage, the result will be poor riding track, and increased maintenance cost. It is difficult to maintain track in good line and surface that is out of gage. The time to obtain good gage is at the time the rail is laid; then maintain it.

In an effort to avoid train delays under present high speed operation, a

train is frequently permitted to move over newly-laid rail at too high a speed before the tie plates have become properly seated. The maintenance man is required to live with the conditions that exist after the rail is laid; therefore good workmanship in laying the rail is essential.

It Is Highly Important That the Rail Be Put to Proper Gage When It Is Laid

Track which is out of line naturally will permit a greater thrust on one rail, depending upon which rail is low. This has a tendency to loosen the spikes, causing the gage to widen; the same is true where track is out of surface and line.

Where rail has excessive wear on the high side of a curve, the gage will become proportionately wide. The flange wear on the rail, particularly on curves, will be more excessive where the alinement is irregular, and where the gage is irregular the tendency will be for the gage to widen.

Especially on single track where train movements are in both directions, and both slow and fast, the inner rail may, in many cases, have a tendency to tip out due to the superelevation, resulting in improper gage.

The condition of the track structure bears a very important relation to the maintenance of proper gage. For illustration, the poorer the tie, the less the spike-holding resistance.

Excessive side lateral play in equipment has a very direct bearing on gage conditions due to the increased lateral thrust against the rail. Where this condition exists and where rail on one side creeps more than on the other side, ties will slew. Where slewed ties exist, incorrect gage exists.

Means of Correcting

Of most importance is the obtaining of correct gage to start with; then maintain it. Gage is corrected by pulling the spikes, plugging the spike holes, forcing the rail to correct gage and redriving the spikes. Good ties, proper anchoring of track, use of double shoulder tie plates, exact gage tools, proper spiking, good line and surface, all contribute to gage conditions.

In special cases, gage rods may be used as well as adjustable gage plates at switches, additional spikes on curves, widening of gage on sharp curves, proper super-elevation of curves in relation to speed and tonnage, additional spikes for anchoring the plates, rail lubrication to prevent flange wear of rail, spikes up against the rail and driven down and frequent checks as to gage conditions.

The committee calls attention to the variations in methods and practice that exist among the American railroads relative to the use of additional spikes on curves to decrease the tendency of the rails to spread, as well as to overturn under traffic, and also to the variation in practice regarding the use of additional spikes as hold-down or anchor spikes, with double shoulder tie plates on both curves and tangents.

In conclusion, high speed operation is much more prevalent today than in the past, and therefore irregularities in gage affect the riding qualities of the track. This is more especially true where the lighter streamlined equipment is in use. Irregularities in alinement of the track are more noticeable at high speeds than slight irregularities in surface. Therefore, good gage is a necessity.

Rail Lubricators Have an Important Effect on Maintaining Gage on Curves

Committee—W. E. Heimerdinger, (Chairman) supt., C. R. I. & P., Ft. Worth, Tex.; P. L. Koehler, (Vice-Chairman) div. engr., C. & O., Ashland, Ky.; G. W. Benson, supvr., C. of Ga., Macon, Ga.; L. C. Blanchard, rdm., C. M. St. P. & P., Spencer, Iowa; W. E. Chapman, supvr., C. of Ga., Columbus, Ga.; J. S. Davis, supvr., Norf. Sou., Edenton, N.C.; P. DiFore, gen. for., C. P. R., Montreal, Que.; J. G. Gilley, supvr., C. & O., Pikesville, Ky.; A. J. Johnson, asst. rdm., C. & N. W., Chicago; J. D. Kirkland, supvr., C. R. I. & P., Herington, Kan.; W. E. Manning, std. app., Southern, Danville, Va.; J. A. Rust, rdm., Southern, Winston-Salem, N.C.; J. C. Runyon, supvr., C. & O., Covington, Ky.; F. F. Scoggin, supvr., Southern, Greensboro, N.C.; R. B. Smith, supvr., C. R. I. & P., Wichita, Kan.; W. H. Sparks, gen. insp. trk., C. & O., Russell, K.; G. A. Stevens, supvr., L. & N., Richmond, Ky.; G. E. Stewart, rdm., S. P., Merced, Cal.; J. R. Vaughan, supt., Utah, Helper, Utah; R. A. Williams, rdm., C. B. & Q., Wymore, Neb.

Discussion

E. L. Banion (A.T.& S.F.) said that wide gage on high-speed heavy-traffic main lines, which were laid with heavy rail, was becoming hard to find; that the tendency on such lines was for the track to develop gage from 1/16 to ⅛ in. tight, shortly after the rail was laid. This, he said, was brought about usually by the uneven settling of unbalanced tie plates, which permit the concentration of more load on the inside area of the plate and thus greater settlement of that end of the plate on the tie under traffic. He added that the widening of gage on curves due to rail wear should not be much of a problem, because of the fact that when rail wear has occurred to this extent it is usually economical to transpose the rails on the curve, which will automatically correct the wide gage condition. On very sharp curves, he said, the turning out or tipping outward of the rail is frequently brought about by putting these curves to exact gage rather than wide gage when the rail is laid.

President Sitton said that the Southern had experienced difficulties with unbalanced tie plates that have too small an area on the inside end of the plate, causing tight gage to develop under traffic. G. B. McClellan (T.& P.) said that a variation in gage from ⅛ in. tight to ⅛ in. wide would produce undesirable riding conditions in present-day high-speed trains.

John J. Clutz (Penna.) pointed out that good gage was particularly important for high-speed trains, that in rail relay work it was difficult to secure exact gage with canted tie plates, and that frequently the total variation in gage after the rail relay was as much as ⅜ in. He added that the Pennsylvania has overcome this by driving only the rail spikes when the rail is laid and then regaging later where necessary, driving the holdown or anchor spikes by hand in a manner to correct small variations in gage.

These latter spikes, he said, can be driven to pull the plate 1/16 in. in either direction. This work is done after the surfacing work following the rail laying. Continuing, Mr. Clutz said that the Pennsylvania lays its high-speed main line tracks to a gage of 4 ft. 8⅜ in. instead of 4 ft. 8½ in., which reduces nosing, side slap and play of the trucks between the rails.

P. Chicoine (C.P.) said that he had experienced trouble with minor variations in gage after rail relay work and suggested that this could be caused by a slight tilting of the rail during the gaging and spiking operations. He added that he had tried using a base gage for rail relay work and had found that the gage of the track, after traffic had seated the tie plates and the rail, was much more uniform.

The Effect of Weight of Rail on Track Maintenance

Report of Committee

I. H. Schram
Chairman

THE subject of this Committee's work is one that every maintenance officer has had to consider for many years, and is so closely related to another similar subject—the selection of the most economical rail section for a railroad or district thereof—that it has been considered in various phases for many years. Wellington, in his Economic Theory of Railway Location, said of this kindred subject: "In buying rails we are not buying steel; at least we do not care to buy it. We are buying three imponderable qualities: (1) stiffness, (2) strength, (3) durability. If we get our money's worth of these qualities, it is a matter of complete indifference whether we get much or little of steel. If we do not get our money's worth of what we want, our bargain is just as bad however much steel we get." These same qualities are fundamental today but fortunately they have been so considered in the designs of the A.R.E.A. that we can be sure that if we select the standard sections of that Association we are getting the maximum benefits of the metal in each weight.

Reduces Labor Costs

During the past several years, and particularly since 1934, a new factor has been introduced in track maintenance by increases in the speeds of both freight and passenger trains. There have also been added the necessity for assurance of smooth riding track and freedom from track defects that might endanger safety at the high speeds at which modern trains are being operated over many railroads. For these reasons there has been a noticeable trend toward the extended use of heavy rail sections. Generally the decision to use the heavier sections has been influenced by the fact that the lighter rail in use was not giving satisfactory service and in most cases the railroad managements making the change foresaw that with the still heavier wheel loads and the higher speeds, the amount of labor required to maintain proper standards would increase, together with other track costs. Generally consideration was given to the fact that the heavier rail would have a longer life, with resultant economies, but the savings that could be made in labor and material were not often considered.

Man-Hours Used Per Million Gross Ton Miles Per Equated Mile For Various Weights of Rail

Group Class	Averages for Years 1927-8-9				Averages for Year 1936		
	No. of Rwys.	Section man-hours per equated mile per annum	Gross ton-miles per equated mile per annum	Section man-hrs. per million gross ton-miles per equated miles	Section man-hours per equated mile per annum	Gross ton-miles per equated mile per annum	Section man-hours per million gross ton-miles per equated mile
131 lb.	18	3,035	7,517,761	403.71	1,564	7,296,310	214.36
112 lb.	28	2,362	4,754,770	496.76	1,229	4,199,188	292.68
100 lb.	21	2,103	3,897,706	539.55	1,136	3,427,224	331.46
90 lbs.	26	2,196	3,359,940	653.58	1,125	2,700,579	416.58

A.R.E.A. Studies

However, since the same period has been one of decreasing track costs, caused perhaps by several factors, there has been abundant opportunity to study the effects of the heavier rail section. Both the committee on Economics of Railway Labor and on Economics of Railway Location and Operation of the A.R.E.A. have given deep and careful study to the matter and their reports have been used extensively by this Committee in its consideration of the subject. In its report for 1939 the latter Committee submitted some maintenance information in connection with the man hours used per million gross ton miles per equated mile for various weights of rail, and has compared this for the year 1936 with the averages for the years 1927-8-9 as shown in the table.

It will be noted that the section man hours per million gross ton miles per equated mile definitely increase as the rail weight decreases. The Committee on Economics of Railway Location and Operation examined the records of 93 railways reported to the Interstate Commerce Commission. It found that the railways included in the study had definitely classified themselves, through traffic densities attained by that time, into the four groups shown in the table, namely 130 lb, 110 lb. and 90 lb. or less. For modern purposes, the 131 lb. and 112 lb. classes were shown in the table.

Another very interesting table presented in the above report of that committee appears on the next page.

Examination of the figures discloses that while the heavier weight

rail group effected a slightly greater reduction in section man-hours per equated mile, the advantage is further emphasized by the progressively diminishing results in the percentage reduction of section man-hours per million gross ton miles per equated mile.

Percentage of Reduction from 1927-8-9 to 1936

Group, Lb. per Yard	Section man hrs. per equated mile percent	Gross ton miles per equated mile percent	Section man-hours per million gross ton-miles per equated mile percent
131	48.5	2.9	46.9
112	48.0	11.7	41.1
100	46.0	12.1	38.6
90	48.8	19.6	36.3

Briefly, as the weight of rail decreases, ability to decrease labor costs also decreases.

Some Examples

Some individual examples of the same kind can be given. The Erie has a heavy duty track from Port Jervis, N.Y., to Lackawaxen, Pa., a distance of 20.35 miles, that carries its eastbound hard coal and most of its soft coal and merchandise traffic. The record of traffic and man hours used from 1929 to 1938 on this track are:

Year	Gross tons eastbound	Man Hours
1929	25,281,067	87,267
1930	23,105,020	88,623
1931	21,443,808	80,653
1932	17,967,233	60,128
1933	17,057,938	56,102
1934	18,438,132	56,398
1935	17,246,382	65,611
1936	17,157,947	55,198
1937	17,669,866	54,924
1938	16,438,104	52,448

During this time the rail section was changed from 110 lb. to 130 lb. or 131 lb.

In comparing the first 5 years with the last 5 years it will be noted that there has been a reduction of 23.66 percent in man hours. In addition, the rail renewals have decreased about 50 percent and tie renewals have decreased from 205 to 80 per mile. This railroad is 73.4 percent curves, of which 31.2 percent are 5 deg. or heavier. In the ten-year period, it was completely equipped with curve lubricators, which no doubt greatly added to rail life, and all tie renewals during this period were made with treated ties.

One of the members of this committee, N. V. Fehn, supervisor, L. & N., Russellville, Ky., has given us information on a stretch of track where 131 lb. rail is replacing 100 lb. Some of the data are, of course, assumed. This information is as follows:

Alinement—Tangent 52 percent; curve 48 percent.
Tonnage—Approximately 25,000,000 per year.
Average life 100 lb. rail—Tangent 14 years; curve 8 years.
Average life 131 lb. rail—Tangent 18 years; curve 10 years.
Average life 100 lb. plates—20 years.
Average life 131 lb. plates—30 years.
Average life creosoted ties under 100 lb. rail and plates—Tangent 16 years; Curve 12 years.
Average life creosoted ties under 131 lb. rail and plates—Tangent 24 years; Curve 20 years.
Average life all fastenings—Same as that of rail.
Total cost of laying 1 track mile of 100 lb. rail, including fastenings—$9,837.12 (exclusive of labor).
Total cost of laying 1 track mile of 131 lb. rail, including fastenings—$13,225.98 (exclusive of labor).
Excess cost of 131 lb. rail and fastenings over 100 lb.—$3,388.86 per mile.
Saving per mile per year—$126.30.

J. M. Farrin of the Illinois Central, who has worked out some very valuable formulas and tables for the subcommittee of the Rail committee on economics of the different sizes of rails, has submitted a chart which that committee has not yet published, showing the ratios of annual expense of different sizes of rail in terms of 152-lb. rail and has recently had an opportunity to test labor maintenance for different sizes of rails actually in test sections of track and for the year 1938 has compared the actual costs with those from his chart, which are shown for several rail weights and traffic densities as follows:

Weight of Rail	Age Years	Length Test Section Miles	Traffic Density Tons per year	Labor cost per million gross ton miles per mile: Actual	Labor cost per million gross ton miles per mile: From Chart
85 lb.	16	35	4,597,000	$65	$65
100 lb.	9	25	4,156,000	44	50
127 lb.	6	35	4,597,000	34	37

Mr. Faries Report

Many of those present doubtless have read in the May issue of *Railway Engineering and Maintenance*, the abstract of the testimony that the late Robt. Faries, assistant chief engineer-maintenance of the Pennsylvania, presented before the Wage and Hour division of the Department of Labor. Mr. Faries said:

"Similar studies were made to determine the effect of increased investment in rail, that is, the effect on employment of the use of heavier rail, the comparison being made between 100 and 131 lb. rail carrying an annual traffic of 16,500,000 gross tons per mile. In making these studies, the costs for each weight of rail were reduced to the annual basis for both investment and maintenance at each rate of wages. It was found that at the 30-cent rate, the use of the heavier rail increased the annual investment per mile of track by $75, but reduced the annual expenditure for maintenance by $95. Likewise, at the 35-cent rate these figures become $72 and $113; and at the 40-cent rate they are $69 and $133."

From all of the above studies the labor saving in the use of heavy rail sections is apparent and is explained

At Least Two Roads, the Pennsylvania and the Bessemer & Lake Erie, Are Employing Rail of 152-lb. Section on their Heaviest Tonnage Lines

in various ways. Owing to the increase in stiffness, both vertically and laterally, as the weight of the rail increases, and the consequent better distribution of loads over the ballast, there is a considerable reduction in the amount of labor needed to keep the track in line and surface. This has been found to vary greatly, but estimates made by maintenance officers for the Committee on Economics of Railway Labor of the A.R.E.A. ranged from 20 to 50 percent. It was also found that the savings in this item varied definitely with the volume of traffic and the speed of trains. Of course, other things that go with heavier rail contributed to the result. Heavier rail means deeper fishing space and, therefore, better joints; larger, heavier and better designed tie plates are usual and improved tie fastenings were often used with the

heavier rail. Pre-adzed ties, pre-boring and mechanical adzing are also great aids in holding gage.

Other Economies

Track inspection can be and has been greatly reduced with the use of heavier rail sections and track walking has been entirely eliminated on many hundred miles of tracks and while some substitutes are in use their cost is much less than that of track walkers. It has been found on many railroads that minor soft spots in subgrade either cease to trouble or are less serious and much less time has to be spent at such places by trackmen when heavier rail distributes the loads over a greater length of track.

There is no doubt that heavy rail increases the life of ballast, as stiffer rail has less wave motion under wheel loads and the ties, therefore, have less vertical movement. These vertical movements or blows not only break up ballast but drive dirt up from the subballast and foul the ballast. When the ballast is wet, it then churns, resulting in the necessity for increased surfacing, lining and ultimately in ballast cleaning or renewals. This action is most noticeable at joints and it is stated that the cost of maintaining a churning joint is 2½ to 4 times that of a joint that is not pumping.

Increasing the weight of rail increases the life of the ties by decreasing the abuse to which they are subjected in service. By reason of its greater girder strength, the larger rail distributes the traffic load over a greater number of ties, thus reducing the load on the individual ties. Although they are entirely independent of, but usually incidental to heavy rail, large tie plates also contribute to decreasing the intensity of pressure on the ties by spreading the reduced load over a greater area of the surface of the ties. Ties fail in large numbers as a result of abrasion induced by relative movement between the tie plate and the tie, and this mechanical action is greatly increased by the wave motion in the rail. Since the heavy rail is stiffer, it has less wave motion and thus prolongs the life of ties that are subject to failure from plate cutting. Independent fastenings for the tie plates still further reduce this type of mechanical destruction.

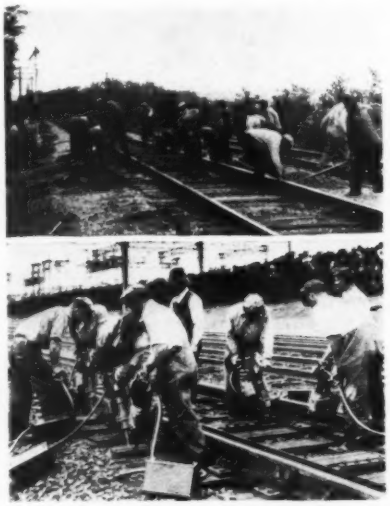
Lessens Spike Cutting

Spike cutting is another fertile source of tie failure, and because rail renewals are less frequent and less gaging is required with the heavier and larger tie plates, the life of ties subject to this type of failure is prolonged. Because of the many other factors that affect tie life, however, such as the species of wood, the type of treatment, the practice of pre-adzing and pre-boring, the character and condition of the ballast and others that are in no wise related to the weight of the rail, it is not possible to state in concrete terms the effect of increased weight of rail on the labor involved in tie renewals, although it is clearly apparent that the heavy rail will result in an increase in the life of the ties, and thus effect a reduction in the labor required for tie renewals.

The increased life of the heavier rail itself is now showing up. Its extent depends on the difference in the weight of the two sections; the design of the joints, whether the rail ends are heat treated, alinement and grades of the road, curve lubrication, traffic, axle loads, speeds, ballast drainage and the standard of maintenance.

A Service Record

One road, when deciding on heavier rail, ignored the saving in labor for track maintenance, basing its decision to apply 130-lb. rail in place of 100-lb.



The Section of Rail Employed Has a Marked Influence on These Two Classes of Maintenance of Way Work—Tie Renewals and Surfacing Track

rail on the annual capitalized cost of the rail. On a district having 23,000,000 gross tons of traffic per mile of track per year, it was calculated that since the 100-lb. rail had an average life of 5½ years, the 130-lb. section would have to last 8½ years, or 55 percent longer, to equalize the cost. As a matter of record, the 130-lb. rail has now been in service for 9 years with no removals and the minimum life will be at least 10 years, with the average considerably more. This illustrates a situation that has a definite bearing on the effect of heavier rail on track labor, for where the life of the rail is increased 50 percent, compared with the light rail it displaces, the labor cost of rail renewal is reduced by one-third; if the life is doubled the labor cost for this item is cut in half; and if the life of the rail can be extended 2½ times, the labor for laying rail will be 60 percent less. Actual experience in the saving effected in this item of track labor ranged from 20 to 60 percent. On curved tracks the difference may be greater. For instance, the chairman of this committee has had supervision over six-degree curves on heavy duty track where 110-lb. rail had a life of less than 2 years, but where 130-lb. rail laid 10 years ago is still in service.

Committee—I. H. Schram, (Chairman) engr. m.w., Erie, Jersey City, N. J.; C. W. Baldridge, asst. engr., A.T. & S.F., Chicago; F. G. Campbell, asst. ch. engr., E. J. & E., Joliet, Ill.; Armstrong Chinn, ch. engr., Alton, Chicago; John Clark, supvr., B. & O., Walkerton, Ind.; N. V. Fehn, supvr., L. & N., Russellville, Ky.; W. Goodwin, III, supvr., Southern, Winston-Salem, N. C.; R. W. Grigg, supvr., Penna., New Brunswick, N. J.; W. H. Haggerty, supvr., N. Y., N. H. & H., New Rochelle, N. Y.; J. B. Kelly, gen. rdm., Soo Line, Stevens Point, Wis.; G. S. King, supvr., Southern, Blackville, S. C.; W. F. Monahan, gen. trk. insps., S. P., San Francisco, Cal.; G. M. O'Rourke, dist. engr., I. C., Chicago; C. W. Russell, rdm., Southern, Greenville, S. C.; H. W. Steger, supvr., Jacksonville Term. R.R., Jacksonville, Fla.; I. D. Talmadge, rdm., N. Y. O. & W., Oneida, N. Y.; John Vreeland, asso. ed., *Railway Engineering and Maintenance*, Chicago; G. E. Yahn, dist. engr. m. w., C. B. & Q., Burlington, Iowa.

Discussion

A long discussion followed the presentation of the report, in which estimates were given, ranging up to as much as 90 per cent, of the reduction that can be made in the cost of routine track surfacing after heavy rail has replaced rail that is too light to carry the traffic. The general opinion seemed to be, however, that the reduction in labor for maintaining line and surface will ordinarily range from 20 to 50 per cent, depending somewhat on the weight of the rail displaced.

The discussion then turned at some length to the relative costs of laying rail of different weights where full use is made of power equipment; where the rail is laid entirely by manual methods; and to the relative costs of the two methods for given weights of rail. No definite figures were quoted, but it was stated that in giving his testimony before the Wage and Hour division, referred to in the

report, Mr. Faries had estimated the labor cost to be the same per mile for laying heavy and light rail by machine, at each wage level. The consensus, as expressed, was, however, that there is some differential between the labor for laying light and heavy rail. W. A. Moberly (C. M. St. P. & P.) estimated a saving of 12 manhours per mile for laying 131-lb. rail by machine methods, as compared with the cost for 100-lb. rail.

Ditching and Bank Widening—Methods and Equipment Best Suited

Report of Committee

C. Halverson
Chairman

AN adequate system of roadbed drainage is essential to economical track maintenance and every reasonable means should be employed to intercept water from outside sources before it reaches the roadbed, as well as to provide for the drainage of the roadbed itself. The necessity for widening banks is closely related to ditching and drainage, for the sloughing off and erosion of slopes create conditions which must be repaired frequently in order to strengthen and stabilize embankments and to provide the proper width of roadway prior to reballasting.

The methods of doing ditching and bank widening have been subjected to constant change in recent years by reason of increased wage scales and the development of machines designed particularly for this work. These changes have been progressive from the era of all hand work during the early years when low wages prevailed and machines were not available, to the present day with its extensive use of various types of equipment, including the trend toward off-track machines. Local conditions, such as the character and extent of the work, the availability of borrow pits and the height of fills usually govern the selection of the most economical methods of carrying out a ditching and bank widening program, but usually hand methods and those involving rail-bound equipment are expensive and are being superseded generally by off-track machines.

Hand work is probably the most expensive method of ditching. Furthermore, the material removed is frequently cast where it will soon be carried back into the ditch by surface water. Hand work should be confined to locations where the volume of material to be handled is small, to the clearing away of obstructions, and where other methods are not economical. The general use of work trains with flat cars and a Lidgerwood unloader, in connection with hand ditching, was discarded many years ago and such equipment is now employed only in areas with restricted clearances, such as in tunnels and subways.

On-Track Vs. Off-Track Equipment

While at one time teams provided a popular means of ditching and widening banks, they have been superseded by efficient machines which perform much better work at lower cost. In the past, steam shovels and cranes were also used extensively for loading trains of dump cars, or flat bottom cars which were unloaded by Lidgerwood plows. This method was employed for extensive bank widening programs, and required the spotting of cars for loading, a train for unloading, the use of a spreader, a large amount of equipment and a large force. Another disadvantage included the fouling of ballast with material dropped from the cars in transit and during unloading. Because of the expense and traffic delays, this method has been discarded in favor of more economical off-track equipment, such as crawler cranes equipped with draglines, tractors with bulldozer and angle blades, graders and scrapers.

The ditcher-spreader is economical for cleaning out side ditches in cuts, where the material is dragged or pushed to the end of the cut. This machine superseded hand ditching and it is still used extensively. It has the disadvantage of being a rail-bound machine and its use is restricted to cuts of clay, dirt and gravel.

While the crane-type ditcher is not now used as extensively as in the past, it is still employed by some roads which group two or more machines in the same work train, thereby reducing costs. The ditcher is adaptable for use in shale or rock cuts and can be used in place of a steam shovel for loading material. Moreover, it is used where other methods are unsuccessful and is available as a crane for handling light loads.

On some railroads the ditcher is removed from its flat car and used as a steam shovel, traveling on short lengths of track within loading reach of the main track, the excavated material being loaded into dump boxes mounted on push cars. Two heavy-duty motor cars can handle five trailer cars with two dump boxes on each car. This method has proved satisfactory where the haul is one mile or less and where conditions are such that one unit can be operated in each direction from the ditcher. A portable turntable is provided for removing the equipment from tracks to clear trains.

Crawler cranes equipped with draglines are coming into general use for ditching, widening and sloping banks and a variety of other tasks. They are not restricted as to movement and are not delayed by traffic as is the case with rail-bound equipment. Gasoline or Diesel engines simplify fuel and servicing problems. Two men comprise the crew so that supervision and attention are reduced to a minimum. The principal disadvantages when working on the right-of-way are the restrictions imposed by the presence of signal and wire lines.

Crawler tractors are normally operated by one man and may be equipped with bulldozer and angle blades, plows, front-end loaders, and

other attachments for special tasks. They are adapted particularly to working under wire lines and around obstructions which would hamper other equipment seriously, to sloping and widening embankments where borrow is available, to cleaning out and forming shallow ditches and, in many cases, to cleaning out cuts. Their greatest use is in sloping and widening fills with maximum heights of six to eight feet. The slopes are usually well buttressed and subgrades are extended somewhat wider than former standards required, to facilitate the movement of equipment and assure well-packed fills which are less subject to settlement and washing by heavy rains.

Where cuts and fills are light and rock is not present, a grader hauled by a crawler tractor comprises one of the most efficient methods for ditching and sloping and widening banks. The machines are operated by a two-man crew and delays on account of traffic are negligible.

Crawler cranes equipped with draglines, crawler tractors with bulldozer and angle blades, and tractor graders are rapidly eliminating the use of railbound machines. Off-track equipment can perform a variety of tasks; it is not restricted to the rails; it can be moved to the work easily; it is efficient and in many instances provides the most economical means of carrying on many types of work.

Tractors Are Finding a Large Place in Ditching, Bank-Widening and Similar Classes of Maintenance Work

Surface Ditches

Surface ditches, properly maintained, are essential to the maintenance of good track. Proper care should be exercised in determining the depth of the side ditches which will carry off all of the surface water and thus reduce to a minimum the amount of moisture within the roadbed. These ditches should be maintained well below the subgrade, of sufficient capacity to handle the surface water during periods of normal precipitation and should be so shaped that they can be cleaned easily if material is washed into them from seepage through the slopes. Ditches should be not less than one foot below subgrade, not less than a foot wide at the bottom, maintained to a correct grade, and with the ends diverted from the track to keep water away from the roadbed.

Through long cuts where the ditches have not been widened and where considerable material has washed in from seepage through side slopes, the ditcher-spreader presents an economical means of cleaning and shaping. The material thus removed may be shoved through the cut and applied to strengthen the adjoining fills. Good judgment must be used in operating the ditcher-spreader, for where cuts are narrow and deep and where the soil is of a permeable nature, the sodded slopes should not be disturbed; if the sod is removed, water seepage through the slopes will cause material to be washed into the ditches, an action which will continue until the slopes are sodded over. It is considered advisable to clean out such ditches during both spring and fall, but where a ditcher-spreader is available one cleaning each year will suffice. Fall operation is preferable, for dead vegetation can be removed from the side slopes and ditches, leaving them clean and free of obstructions for winter snow and for the flow of water during the spring run-off.

Through cuts where side ditches are not of sufficient depth to carry off the normal precipitation and the spring run-off and where it is not practicable to deepen the ditches because of the existing grade, good results are obtained by giving the track a ballast lift; this provides increased ditch capacity, reduces the amount of water seepage into the roadbed and subsequently decreases the heaving of track through the cut. Ballast stakes should be set in order to insure that the contour of the ditch conforms to the grade. Each section foreman should be familiar with the profile of the track under his jurisdiction so that the various changes in grade can be studied and such knowledge applied in maintaining proper surface drainage.

Ditching With Off-Track Equipment

Through shallow cuts where the topography of the adjacent land is such that the surface water drains to the right-of-way, excellent results have been obtained with the use of crawler tractor and carry-all equipment in cutting a wide surface ditch about 6 ft. below and parallel to the top of rail. This ditch is usually located 10 or 12 ft. beyond the outside rail, thus providing a wide subgrade to protect the roadbed from frost and the ditch is dug deep enough to provide drainage below the frost line.

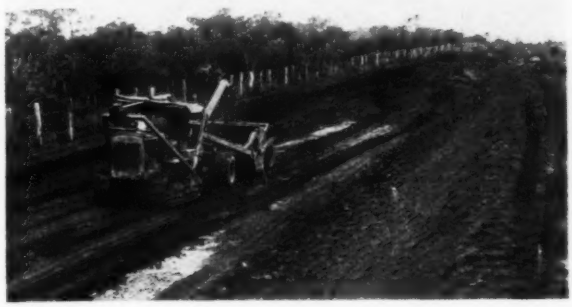
This type of ditching has considerable merit when used under favorable conditions, especially where the character of the ground is such that it may be drained readily. Under these conditions, heaving track can be eliminated and the only maintenance cost involved is entailed by an occasional trip through the cut with the tractor equipment. However, where the roadbed consists of dense clay, capillary attraction is such that successful drainage cannot be secured in this manner, even with the excavation of parallel open ditches 6 ft. below the top of the rail.

The material removed from shallow cuts in the process of ditching may be wasted on adjacent fills, thus providing additional bank widening at small cost. On some railroads the crawler dragline is used for cleaning out ditches, which permits casting the material back from the slope of the cut, the dragline being operated from the top of the cut and a tractor with a bulldozer or angle blade being used to level off the waste material.

Tractors with bulldozer or angle blades and the carry-all type scraper are being used extensively to clean out and widen ditches and have replaced, to a large extent, the locomotive crane type ditcher, as well as the steam ditcher operated from a flat car that was formerly used in conjunction with air dump cars and a work train. Not only has the use of off-track equipment greatly reduced the cost of ditching but it also has eliminated expensive train delays and has made available for other maintenance work, such track machines as were formerly used for ditching operations.

One road reports that it has es-

tablished a regular program for ditching with off-track equipment. Accurate data regarding the location of heaving track and the use of shims form a definite basis for field surveys and studies which reveal the source of trouble, the character of the soil and the determination of an effective ditching method to correct the condition as well as deciding the disposition of the excavated material. The program provides for the ditching of selected cuts each year, for grade stakes which are set by members of the engineering corps. Material excavated with the tractor and carry-all equipment is wasted on fills to widen and strengthen the roadbed, to fill in old borrow pits, and to widen and improve the approaches to highway crossings.



Large Capacity Carry-alls, Designed for Heavy Grading Operations, Are Being Used Effectively by Several Roads

The tractor bulldozer, carry-all scraper and tractor crane with dragline also present economical and efficient means of cleaning connecting ditches between track and highway drainage systems. When such work is performed in the fall, it assures open ditches and often precludes overflow of the banks during the spring run-off.

Incidentally the view at highway crossings frequently is improved by the removal of additional material at small cost during ditching operations. Furthermore, in shallow cuts where trouble has been experienced previously with snow and it has been necessary to erect and maintain snow fences, the excavation of excess material and the establishing of gentle slopes during ditching operations have remedied the situation so that snow fences are no longer required and substantial reductions are effected in track maintenance costs.

One of the northwestern roads reports an interesting type of bank widening and drainage program through flat prairie country. Carried on at reasonable cost, it involves the use of off-track equipment and results in improved drainage, dry roadbed, strengthening the subgrade and improving the general appearance of the property. The old ditches, which extended parallel to and along the toe of the embankments, were filled in and material was cast up along the embankment by elevating graders and crawler tractors. New parallel ditches were excavated along the edge of right-of-way lines and the embankments were sloped from 2½ to 3 to 1 in order to provide a free run-off for surface water.

As soon as the work in one section was completed, all slopes and surfaces, including the outer edges of the ditches, were trimmed, smoothed and seeded with Brome grass. These provisions permit the free movement of farm machinery and adjoining property owners are induced to harvest the hay crop on the right-of-way each year without cost to the railway company.

Bank Widening on High Fills

Off-track equipment has also proved its efficiency in bank widening operations on high fills. In such instances it is sometimes necessary to purchase additional right-of-way in order to secure sufficient borrow material. The use of crawler tractors with various attachments, crawler cranes with draglines, carry-all scrapers and elevating graders has been reported by several roads. Excavated material is usually piled in windrows at the toe of the slope by tractors equipped with bulldozer or angle blades or scrapers or by elevating graders, from whence it is placed on the slope by draglines.

The widening of embankments should be uniform, of standard width designed to provide good drainage and all materials should be placed in such manner as to provide a solid bond with the old embankment. Proper provisions should be made to drain all borrow pits along the right-of-way by restricting the maximum depth of excavation to the same elevation as that of the invert of the nearest culvert. Moreover, the pits should be trimmed, left with a neat appearance, and sloped to drain away from the roadbed to the outer margin of the right-of-way.

The use of air-operated dump cars provides an economical means of delivering material for the proper side support of fills at bridge ends and other points where material is not readily available. These cars can be handled in local way freight trains without additional cost. Strippings from gravel pits are preferable to gravel for filling around bridge ends because they cause less damage to the wood fibre of piling and bulkheads. The strengthening of fills at the ends of bridges is of major importance in providing good riding track, for track is difficult to maintain on a weak fill where material continually loosens and runs down the embankment.

On high fills where the ground is not favorable to the operation of off-track equipment, bank widening can also be done economically with air-operated dump cars in local freight trains. Usually in such instances the number of cars handled per day is restricted to prevent interference with regular train movements, although when experienced

Crawler-Mounted Cranes, Equipped With Dragline Buckets, Are Effective in Strengthening the Shoulders of High Fills

men are assigned to handle the dumping of cars, delays to the regular trains are reduced to a minimum.

Committee—C. Halverson (chairman), div. rdm., G. N., Grand Forks, N.D.; A. B. Chaney (vice-chairman), dist. engr., M. P., Little Rock, Ark.; J. F. Barron, rdm., Sou., Selma, Ala.; A. J. Butler, supv., I. C., Gilman, Ill.; H. H. Britton, rdm., N. Y. C., Albion, Mich.; C. M. Burpee, managing editor, Railway Engineering and Maintenance Cyclopedia, Chicago; C. F. Edwards, supv., C. & O., Columbus, Ohio; M. E. Flowers, supv., C. R. I. & P., Boonville, Ark.; G. J. Giles, supr., L. & N., Harlan, Ky.; Omer Gosselin, rdm., C. P., Aroostook Jct., N.B.; A. E. Hendricks, supv., Sou., So. Clarksville, Va.; W. C. Johnson, stdt. appr., Sou., Cincinnati,

Ohio; V. I. Kessinger, rdm., A. T. & S. F., Independence, Kan.; R. H. Millikin, rdm., C. P., Trenton, Ont., Canada; J. M. Murphy, rdm., C. M. St. P. & P., Sioux Falls, S.D.; Wm. O'Brien, rdm., P. M., Toledo, Ohio; R. T. Osborne, supv., N. S., Star, N.C.; S. Payson, rdm., St. L.-S. F., Enid, Okla.; G. K. Sterling, rdm., C. & N. W., Eagle Grove, Ia.; A. W. Wehner, rdm., S. P., Lake Charles, La.; T. L. Williamson, rdm., S. P., Winnemucca, Nev.

Discussion

Opening the discussion of this report, President Sitton inquired as to the economical length of haul where carryall scrapers are used for ditching and bank widening work, and also asked how off-track equipment could be used on high fills. Chairman Halverson replied that approximately 500 ft. was the economical limit of haul for carry-all scrapers and said that one method used on high fills was to form a wide bench on one side of the fill with the material unloaded for bank widening, and then to use a drag line operating on the bench to cast the bank widening material from the bench to both sides of the embankment. President Sitton remarked that he felt that it was doubtful if off-track equipment could be used economically on long hauls, as compared with on-track ditchers and dump cars, and said that the Southern had done considerable ditching and bank widening successfully with the latter type of equipment at a cost of 10 to 15 cents per cu. yd., using three ditchers and four dump cars, two of 20 cu. yd. capacity and two of 30 cu. yd. capacity, operated in tandem.

R. L. Fox (Sou.) inquired how the off-track equipment could be turned on the shoulders of fills in bank widening work. Chairman Halverson replied that on high fills a drag line frequently was used on a bench as described previously, and that other methods could be used, such as widening the banks more than the required standard to permit turning the equipment, or to operate the equipment all the way across the fill, securing dirt from cuts at each end. E. L. Banion (A.T.& S.F.) stated that he considered the old method of using ditchers and railroad dump cars usually uneconomical for ordinary small ditching work, but that for heavy work, especially when involving long hauls, he considered the use of the crawler shovel with 10 to 15 dump cars an economical method.

W. H. Sparks (C.& O.) stated that his road uses a wide variety of equipment for ditching and bank widening work. In long cuts and other work involving long hauls, he said, ditchers and dump cars are usually used. In short cuts, he said, bulldozers are frequently used, wasting the dirt at the ends of the cuts, and in some places, he pointed out, where side borrow is available, draglines are used for bank widening. He added that the C. & O. is very careful to select good dirt to be used for bank widening purposes, and that frequently the dirt secured from ditching operations is unsuitable.

Mr. Banion stated that on heavy traffic lines it was becoming more and more important to avoid blocking the main line by the use of on-track equipment, and mentioned the use of draglines as being very effective in ditching and bank widening work. He added that the operation of this type of equipment frequently necessitated the purchase of additional right-of-way for waste or borrow, and not infrequently was hampered by interference from telegraph poles and wires.

Welding—Its Uses In Track Work

Report of Committee

R. L. Fox
Chairman

IN order to effect reductions in operating and maintenance costs, the railroads should give thorough consideration to the possibilities of welding and its applications in track work for the life of numerous items of track work has been doubled through rebuilding by electric arc or acetylene welding. The more common welding operations in maintenance of way work include the rebuilding of frogs and crossings, building up switch points, fabricating and repairing steel tires, welding battered rail ends to their original contour, reforming rail ends, welding new shoulders on tie plates, welding rail bonds, reforming or building up worn angle bars, end hardening or heat treating rail, making compromise joints, welding switch stands, building up "engine burn" spots on rails, and welding rails together to eliminate joints, a procedure which is especially desirable through highway or street crossings, depot platform tracks and tunnels.

There are also many other uses for a welding or cutting torch in track work, such as cutting bolts in rail joints, cutting rail, repairing tie tamper tools, making guard rails for crossings, making repairs to track equipment, welding frog plates, and hard-surfacing steam shovel teeth and clam shell buckets.

Welding may be defined as a method of joining metals by fusing the edges or surfaces, causing them to become molten and thereby being fused together.

Types of Welding

Electric welding is the joining of pieces of the same metal by fusion produced by an electric arc. The welding current is passed through the parts to be joined, the resistance offered to the passage of the current at the point of contact producing the welding heat. The arc is established by striking the wire electrode to the work and then withdrawing it to a distance of approximately ⅛ in.

Gas welding is the fusion of metals which have been melted by the flame resulting from the combustion of oxygen and acetylene, the application of the flame being controlled by means of a torch. The heat produced by the oxy-acetylene flame attains a temperature of about 6,000 deg. F., greatly exceeding the melting point of the majority of metals in common use.

In track welding, as in any other welding operation, the strength and durability of the weld depend on the fusion obtained between the parent

and added metal, and to get the best results, great care should be exercised to obtain perfect fusion.

Gas Welding

Building up Rail Ends

Preparatory work includes the tightening of all joint bolts, and the surfacing of the joint if needed; if joint shims or new joints are to be applied, this should be done before the reforming or welding work is undertaken. In welding rail ends, the amount of material to be added or the height to which the top of the rail end should be built up can be determined by laying a straight edge on top of the rails across the joint. The weld should be started at the joint and worked back far enough to take the batter out. By proper use of the straight edge, the maximum length of the weld can be determined and only sufficient metal need be applied to take out the batter and match up the ends of the rail. When using the flatter method and the rail ends are tight together, the welder should first heat across the joint and cut the ends apart with a hot-cut chisel, being careful to make the cut exactly midway between the rail ends. Each rail should then be built up separately. If a surface grinder is used, the application of metal should be started at the thin end of the batter on the rail near the operator and continued across the rail ends to the opposite end of the batter, the ends then being separted with a slotting grinder. The edge of the rail should be given ¼ in. round and all surplus metal removed, the joint being finished in a neat workmanlike manner. The average cost per joint built up in this manner, including both labor and material, on ten different roads ranges from 63 cents to $1.50 per finished joint.

Many roads still employ the hand hammer and flatter method for finishing the rail ends, although surface grinding is rapidly becoming the accepted method because of the more uniform finish and hardness obtained. Surface grinding is used effectively in locations where the rail ends have previously been welded out-of-face by the flatter method and are being welded for the second time. Here, the surface grinder, a cup-wheel type, is used ahead of the welding gang to match up the rail ends and to remove humps in the weld metal previously applied, the humps being caused by a poor joint condition developing between the time of the first and second weldings. We do not recommend surface grinding a joint until it is low in surface, as is being done on some roads to relieve a "hammer" at the joints. Rather, the ends should be finished level.

When reforming rail ends, the center of the ball of the rail should be heated to a forging heat as far back as the batter extends and while the torch is still playing on the rail end, the helper should strike the sides of the ball of the rail with a sledge hammer. The blows should be square and well down on the side of the ball. If the rail is at the proper heat, this will raise the center of the ball. Heat should then be applied to the rail head more or less in the shape of the letter "U," with the open end of the "U" toward the end of the rail, thus heating the rail head on either side of the center. The flatter and sledge are then brought into play again as before. This will raise the metal from the center out, although if the center of the ball of the rail is not hot, the sledging will affect only the edges of the rail and will not raise the center.

Then heat the rail end to a red heat and drive a proper hot-cut between the rail ends. This will upset the metal as far back as the rail is properly heated. The sides and top of the ball may then be smoothed up with the flatter, working it across the joint to bring the rail ends to the same level. In this operation, one should be sure that there are no laminations, or loose metal, in the finished job. If any flaws appear, they should be melted out and filler rod applied. Any chipped ends can be welded up as usual.

Rail batter of 3/32 in. or less can usually be overcome by this method without the use of any filler rod; however, if any depression remains, a small amount of rod can be added. The average cost of reforming a joint, including both labor and material, varies from 45 cents to 90 cents. A joint finished by the reforming method should be given heat treatment to obtain additional hardness.

Heat-Treating Rail Ends

This work can be done on new rails not already heat treated as well as rails whose ends have been reformed or built up. The process described here is applicable only to ordinary open hearth carbon steel rails. A slight variation may be necessary for special or alloyed rails.

The operator should familiarize himself with the use of the pyrometer, the application of the heat and means of quenching before undertaking the actual operation. To heat-treat rail ends which have been reformed or built up, the procedure is the same as where heat-treating new rail ends except that the drawing temperature should be slightly higher.

In undertaking this work, one first surface grinds the rail ends or uses the flatter to bring the rail ends to a true surface. Then the rail ends are heated to a temperature of 1,500 deg. F., for a distance of not more than three inches or less than two inches. The color should be uniform over the area treated when quench is applied. The rail ends are then beveled with a cross grinder or hot-cut chisel and the bevel is carried ⅜ in. down the side of the ball. In applying heat, a No. 12 tip is used in order to bring the rail ends to the proper quenching

Building Up Battered Rail Ends by Welding Has Improved Riding Conditions and Greatly Extended the Service Life of Rail

temperature without too much heat penetration, the two rail ends being heated uniformly at the same time without allowing the cone of the flame to touch the rail while it is at a high heat in order not to fuse the surface of the rail. When a uniform heat of 1,500 deg. F. is obtained, the rail end is quenched with water immediately to about 300 deg. F. or until the water will remain on the rail and boil but not too violently. After quenching, the next step is to apply enough heat to raise the temperature of the treated area to 650 to 700 deg. F., after which the rail ends are allowed to cool.

A test of 220 heat-treated joints and 220 non-heat-treated joints after six years service, shows that 83 heat-treated joints had an average batter of 0.026 in. and 5 chipped joints averaging ½ in. in length, compared with 122 non-heat-treated joints with a batter of 0.047 in. and 34 chipped joints averaging 1⅛ in. in length. During this test, 1,460,000,000 gross tons had passed over this rail. The average cost per joint, for heat treating, ranges from 28 cents to 75 cents.

In heat treating rail ends, it is important to watch several points carefully, including the following:

1. Have a uniform heat of 1,500 deg. F. when quenching.
2. Use a pyrometer to get the

quenching temperature until the operator can judge accurately the color of the rail at 1,500 deg. F by eye. (Even then, he should check frequently with a pyrometer.)

3. Do not overheat the extreme ends of the rail. Keep the torch back. Do not hold the torch in one spot too long when first heating the rail ends. Distribute the heat uniformly.

4. Do not let the cone of the flame touch the rail while hot, in order to avoid breaking the melting surface.

5. Be careful when drawing not to overheat the rail ends.

6. Rail ends should be beveled before heat-treating.

Heat treating or rail end hardening is also being done by an oxy-acetylene machine. This machine consists of six welding tips of approximately the same size as the tip used in welding. The tips are so arranged that two are near the end of the rail on each side of the joint and one about an inch back of the tip on the gage side of the rail. The heat-treated area at each rail end is about 1½ in. long on the outside of the rail head and about 2½ in. long on the gage side. Gasses are supplied from regular oxygen and acetylene cylinders, but the acetylene is used from five cylinders coupled together. There is an automatic arrangement for turning on the flame and cutting it off quickly. A pilot light is used for igniting the flame. The necessary equipment, hose, valves, etc., are mounted on a four-wheeled frame which moves on the rail. The six tips above mentioned are mounted between the wheels above the rail. When the machine is in the proper position above the joint so the tips will be as outlined above, the valve is moved to ignite the gasses. In 15 to 22 sec., the rail is heated above the critical point (approximately 1,600 deg. F.). The heated portion of the rail end is quickly chilled by the cold rail, thereby increasing the hardness of the heated portion, ranging between 350 and 375 Brinnell. If the rail ends are badly worn or chipped, they are welded or ground to a uniform surface ahead of the end hardening.

Repairing Fishing Surfaces

After the fishing surfaces of a rail joint become badly worn, it is impossible to keep the joint tight. All the defects of a swinging joint materialize. It is impossible to keep the bolts in the joint tight and they are constantly breaking out. The rail ends become battered and if the joint is neglected very long the joint itself is bent or broken.

The most successful way to repair a joint like this is to apply enough metal on the fishing surface of the joint to compensate for metal worn off the joint and off the fishing surface of the rail. This can best be done at a plant constructed for this purpose. It would not be practical or economical to do this in the field.

The plant at which joints are to be repaired should be centrally located and the track serving the plant should be so located as to require the least possible handling of material. The equipment consists of a forge for heating the joints, a straightening bench, a welding rack, an emery wheel and a power unit.

The forge, which has forced draft, has two racks—one for pre-heating the joints and the other for the final heat. When the joints have been heated to a cherry red, they are removed to the straightening bench where they are straightened if necessary. While they are still hot they are taken to the welding rack and enough metal is applied to the top fishing surface of the joints to compensate for the wear of both the joint and the rail. It requires less oxygen and acetylene to apply this metal if it is applied while the joints are still hot. After the joints have cooled enough to handle, the metal which has been applied is dressed down to a smooth surface on the emery wheel. The welder and the operator of the emery wheel both understand the amount of wear to be compensated for and they apply the metal and dress it down accordingly.

The application of a reformed joint to old rail gives a better job than a new joint for it has been built up enough to take care of the wear on the fishing surface of the rail, too. The average cost for labor and material to build up a joint is 80 cents.

Switch Point Welding

Most roads have appreciated the savings to be realized in welding switch points. However, some roads are welding points in yards and on secondary tracks only, while others weld main line points, with a cost per point, for both labor and material, varying from $3.50 to $6.00.

When welding switch points in track, the point should be built up against the rail with which it is to be used. The point will then have the same contour as the rail and there will be less danger of it breaking.

If a small lip or bead is found on the stock rail, this should be removed with a grinder. If no grinder is available, the lip should be heated with a torch and cut off with a hot-cut chisel and the rail smoothed up to give the point a good bearing. After the stock rail has been smoothed up, the switch stand should be adjusted if necessary.

The weld can be started at the point and worked back toward the heel of the switch point, or at the thin heel end and worked toward the point, building from the bottom upward. The amount of metal to be added will depend upon the wear of the point, although it should seldom be necessary to build up much more than 12 or 14 in. This will bring the weld within the limits of the original chamfer cut on the point.

The switch point, when completed, should be ⅛ in. thick at the point and the point ½ in. below the top of the rail it fits against. The point should be rounded to 1½ in. radius and brought to a sharp edge by the use of a rasp while the point is hot. The point can be dressed off with a power grinder if one is available. If the weld is properly made, the back side of the point will be smooth and not laminated.

When doing this work in track, the welder should be protected by flag when necessary. It is important to maintain a long taper on the weld in order to permit the safe movement of trains and engines over the switch, if necessary, before the welding is completed. Under no circumstances should the switch be used while the welded metal is hot. The speed over an unfinished switch point should be restricted, or the movement governed by a hand signal from the welder. In traffic, switch point welding should be confined to yard and secondary tracks. Main line points should be welded out of track where possible.

In most cases, out-of-traffic welding is done in the maintenance of way frog and switch shop, or where table clamps, grinder and other facilities are available. The point is placed work-way on the welding table, with the rear end of the point slightly elevated to allow only the point end to rest on the table. The top edge of the point is cut off with a torch or ground off so that the point is at no place less than 5/32 in. wide on top. (This is to insure removal of all fatigued metal or cheeks and provide good parent metal on which to start weld.)

Welding is started at the point and a bead put on, working back toward the heel of the point. This operation is continued, one bead being laid on top of the other until the required height is reached. When this is done, the point is turned so that the gage side is up and the point is built up to the desired thickness, using a bead weld. The point is then turned back to its original position and one more bead is welded on top as far back as the welding has been done on the side of point.

After the point has cooled, the side which fits against the stock rail is

ground to a true line with the original bevel before the gage side of the point is ground, a straight edge being used to insure good alinement. The distance is measured from the top of the base of the rail at the heel of the switch point to the center of the side of the ball of the rail with calipers or a rule, and this measurement is the proper height of the switch point at the point, measuring from the base to the toe of the point. After striking a line from this point to the top of the point 18 in. back, the point is ground down to this line. The gage side of the point should then be ground to proper surface and alinement. The completed switch point should be ⅛ in. thick at the point, rounded to a 1½-in. radius and should be brought to a sharp edge.

Many Roads Butt-Weld Rails in the Field for Special Purposes, Such as in Highway Crossings and Station Platforms

In view of the favorable laboratory and field tests of many thousands of welded burned spots without a failure so far reported, it is considered advisable to include some instructions for this operation. The building up of engine burned spots in rail outside the limits of the angle bars is a common practice on some railroads; on others the practice has not yet been approved. Therefore, your committee suggests that before this operation is undertaken on railroads that do not approve of the practice, authority for this work should be obtained from the engineer of maintenance or other proper officer.

The welding procedure provides that all loose or laminated metal that cannot be removed with a cold chisel should be washed out with a torch without heating the rail any more than is necessary. If a grinder is available, this loose metal can be removed by grinding. As soon as the loose and defective metal is removed, the weld should be started at one end of the depression, using 3/16-in. rods. If the burned spot is over 4 in. long, the weld should be made in increments of not to exceed 3 in. in length to avoid getting too much heat in the rail. Each weld should be smoothed up with a flatter as the work progresses to avoid reheating. Any overflow metal should be trimmed off with a hot-cut while the weld is hot.

In case of a long weld, each 3-in. weld should be allowed to cool before making the next weld. If a grinder is available, the weld can be smoothed up roughly with a hammer and then ground to surface after the weld is cold. Under no circumstances should the weld be quenched.

Your committee will not attempt to describe how the "continuous butt-welding of rail" should be done but will include "butt-welding rail," as this is being done with our own welders on most railroads. In the latter work, a cutting torch is used to scarf or "vee" out the rail ends to be welded, after which all slag or scale left from the scarfing is cleaned off with a grinder or cold chisel. In scarfing the ball of the rail, the operator starts 1¼ in. from the rail end and makes a cut on an angle of about 40 deg. so that the cut will come out at the end of the rail at the junction of the web and ball. The web is scarfed from both sides on an angle of about 30 deg. so that the cut will meet in the center of the web, the cut being started at the top of the web. To scarf the base, the operator starts to cut at the outer edge of the base and works in toward the web, cutting downward from the top of the base to an angle of about 30 deg. The rails are lined up by the use of a straightedge, leaving a space of ¼ in. between the rails.

The weld should be started at the bottom of the "vee" at the junction of the base and the web and carried up one side of the web to the ball. The other side of the web is then welded in the same manner. The welding of the base is started at the junction of the base and carried out toward the edge. Upon the completion of the weld in the base, the ball of the rail is welded, using the hammer as the work progresses. When the weld is started, it should be completed without interruption.

When the weld is completed, the entire weld and the adjoining rail is heated to about 1,000 deg. F. for a distance of three or four inches on either side of the weld, and covered with ground asbestos or a shield to permit slow cooling. Post heating may be done with either a welding torch or a blow torch.

Open Hearth Rigid, Plain Rail Frog Welding in Traffic

Preparatory to undertaking this work, all bolts should be tightened and any broken or worn bolts renewed; the frog should have uniform bearing, ties being adzed or renewed if necessary; all worn or broken frog plates should be renewed; and all spikes except those in the frog plate back of the actual point of frog should be driven down. Also, wedges should be driven between the base of the frog and the frog plate on each side of the frog to prevent the frog from warping when welding. After the frog has been welded and has cooled, these wedges should be removed.

Welding operations always begin on the point, the actual starting place varying on different styles of frogs and being located by observing the place where the wheels start to mount the wing rails. Welding operations should begin about six inches back from that place, working toward the point and keeping the weld in a slope so as always to be ready for traffic to go over.

When the weld has advanced so that the wheels can get a good bearing on the wing rails, or within 6 or 8 in. of the point, the wing rails can be built up. The point should be built up level with the wing rails to within 6 in. of the point and then sloped toward the point slightly so that the actual point is 3/16 in. lower than the wing rails.

The weld should be brought up to the proper height as the work advances and shaped to the correct section by the use of the hammer, hot chisel and flatter, the work being hammered sufficiently to work the weld into shape. If the point is badly worn and it is necessary to add considerable material where the long and short points join, the points should be built up separately. All over-run metal on the point and wing rails should be cut off with a hot-cut chisel as the work progresses.

To weld these frogs out of traffic, the same welding procedure should be used as when welding in traffic, except that some means must be provided for clamping the frogs down.

Spring Rail Frogs

Spring rail frogs should always be welded out of traffic except when only light welding is needed on the point

or wing rail, and the coil spring then should be protected with a wet burlap. The procedure is the same as for out-of-track welding of rigid frogs.

When repairing these frogs, large savings can be realized by renewing loose rivets in the reinforcing bars on wing rail and base plates, and also hold-down lugs and frog bolts.

When welding rigid crossing frogs, care should be exercised to see that all bolts are tightened, or renewed if necessary, and crossing timbers adzed or renewed to secure good bearing, line and surface. Frog plates should also be renewed if necessary.

Each rail should be built up separately. In case the rails become welded together, the line of the joint should be marked with a chisel to prevent spalling when the rails break apart. The edge of the rail should be rounded ¼ in., the gage line being straight and in true line and the flangeway not less than 1¾ in. wide. On crossings of sharp angles, the end frogs should be built up in a manner similar to an ordinary rigid frog. On center or double-point frogs, the wing rail should be built up first.

Making Compromise or Offset Angle Bars

Some roads use welding to make compromise joints, while others do not recommend its use. However, your committee describes the practice used most widely. When possible, such joints should be welded out of track. These joints are made by using one angle bar of each weight of rail, cutting the bars in half with a cutting torch and scarfing to form a 60-deg. "vee." The bars are then placed together on a rail form, spaced ¼ in. apart at the ends and face bolted, using two rails of the sizes of the compromise joint for the form. The balls of the two rails should be lined up with a straight edge to insure even surface and true line on the gage side of the rail.

The weld is started at the junction of the bottom flange of the angle bar and the web and extended upward to the web. When the web is completed, the bottom flange of the bar is welded. These welds may be slightly reinforced. When the weld is once started, it should be completed without interruption. When the weld is completed, the bars should be heated to about 1,000 deg. F., and then covered with asbestos or a shield to permit slow cooling.

Other Applications

Most of the welding on switch stands is done in the roadway repair shops and is not under the supervision of the track or roadway department.

When rebuilding tie tamper bars, use a self-hardening welding rod. Start the weld at the face of the tamper, running a bead across the worn edge until the desired thickness is attained; then run a bead back to the heel of the tamper, making a uniform surface. After all filler metal has been applied, square up the face of the tamper with a machinist's hammer. Many roads prefer to grind the bars to shape. It is not necessary to hammer the bottom of the tamper back to the heel.

In making guard rails for crossings, pre-heat the base and then start cutting the base of the rail at the outer edge about 10 in. from the end and taper in toward the web until 1½ in. of the base is cut away about 18 in. from the end of the rail; then cut on a straight line until within 18 in. of the other end of the rail or piece of rail, depending on the length of crossing guard the rail is to be used in. Cutting away part of the base will cause the rail to warp. In order to relieve the tension, the rail should be heated with a No. 12 tip at intervals of about 8 ft. and a rail bender applied to bring the guard rail back to a straight line. At 18 in. from each end, heat the guard rail and apply a bender until there will be about 4½ in. of space between the original rail and the guard rail at the end when applied to the crossing. Each end of the guard rail is then tapered, starting at the ball 8 in. from the end of the rail and running out at the base of the web and the end of the rail simultaneously.

Arc Welding

Electric arc welding is used for all manganese steel, such as manganese frogs, self-guarded frogs, crossing frogs, street switches, manganese guard rails and the welding of gage plates for frogs. On some roads, it is being used also for welding switch points, wheel burns, shoulders on tie plates, and for continuous welded rail. On some roads, also, most of the rail-end welding is done by the electric arc.

The building up of manganese frogs, which includes crossing frogs, is one of the major jobs of electric welding, using a nickel manganese welding rod. To determine the advisability of building up frogs or rejecting them for welding, one should make an inspection of the whole frog, noting particularly the structure of the metal and the extent to which the frog is worn through the running surface and at the ends where the rail joins. He should also look closely for cracks in the base section which might cause ultimate failure and examine flangeways for cracks. Cracks near the bottom of flangeways are almost always due to interior defects in the casting, particularly over bolt shrouds. Depressions in the running surface are almost positive evidence of interior defects in the castings, which will eventually crack through into the flangeways. All such defective metal must be completely removed before a permanent weld can be made.

Preparatory to welding all grease and dirt should be cleaned out of flangeways. A frog containing large interior defects should never be welded except in an emergency, or where the additional life of the frog will justify the high cost of the welding. In all rail-bound manganese frogs, all bolts should be tightened. If the nuts do not turn freely, remove the nuts and rethread the bolts, or renew and oil the bolts before replacing the nuts.

All overflow in flangeways, on points and on manganese wings should be ground off. Edge should be examined carefully for cracks. All cracks or laminations should be ground out to sound metal. Thin laminations can be located by the fact that they turn blue while grinding due to their poorer heat conductivity. Never weld over a crack, as eventually it will progress through the weld.

Always grind at least ¼ in. off the top of the point for the point is apt to be laminated due to the great impact at the point. Never remove defective metal with an oxy-acetylene cutting torch unless absolutely necessary, as the heat has a bad effect on the casting. Always place a slow order on the track if a large amount of metal must be removed, which would endanger the movement of trains at full speed.

When welding manganese steel frog castings it is recommended that 3/16-in. bare nickel manganese steel electrodes of the following analysis be used:

Manganese	11 to 15 per cent
Carbon	0.70 to 1.00 per cent
Nickel	3 to 5 per cent
Silicon	0.50 to 1.20 per cent

Use direct current with reversed polarity; i.e., electrode positive. Use the lowest possible current which will give good penetration. The current for 3/16-in. electrodes should be 125-175 amps. If the electrode becomes red hot back to the electrode holder, the current is too high, while if the slag on the head is black and blistered, the current is too low. If the current is correct, the slag will be chocolate brown. Use a short arc. The arc voltage varies considerably due to the

fact that the pool boils. The average arc voltage should not exceed 30 volts. If large drops drip off the electrode, the arc is too long.

Never deposit manganese steel in narrow straight beads without weaving. Deposit the metal in beads about 1 in. wide, with a crescent shaped weaving motion. The pool must be "pottled" until the gasses escape to prevent porosity. Do not deposit more than one full electrode before peening. Peen each bead immediately after depositing with a two or three pound ball peen hammer. Peen the crater first and then the whole bead with the ball end. Smooth up with the flat face of the hammer.

Do not fill intermediated craters. Start the arc for the next bead on the front edge of the crater and weave slowly over the back edge of the crater until it is thoroughly fused. Fill the last crater level without porosity. This can be done by moving the electrode around the edge of the pool in decreasingly smaller circles with an extremely short arc. The electrode should be touched to the pool at intervals and then drawn out before it can stick.

Never quench the bead with water. Stop welding at one location when the casting becomes so hot that it turns blue more than 1 in. away from the last bead. Never deposit a bead parallel to a previous bead until it has time to cool off. Never make a crater on the frog point. The contraction of the weld on the top surface as it cools has a tendency to warp the casting. If each bead is peened to stress as it is cooled, it will reduce warpage and stresses.

Welding a Frog Point

The point should be welded first as it usually requires the greatest amount of welding and has a greater tendency to overheat on account of the thinness of the point. Weld any cavities level. The operator should sit on the frog facing the point. He should strike an arc about ¾ in. from the end of the point and start welding at the end of the point, being sure to get good penetration on the end of the point where the greatest impact occurs. Make the bead overlap the end and side of the point about ⅛ in.

Peen the bead immediately after the first electrode has been deposited. Dress up the edge with the flat face of the hammer. After the first bead has cooled, grind the edges and examine for cracks. Many times interior laminations, which previously could not be seen, crack through to the edge due to the heat and peening. If any cracks are found, grind them out before any more metal is deposited. Never weld over a crack. Weld the first layer in beads from ¾ in. to 1 in. wide. Stop off each layer so that the last layer required to give the desired height is continuous. Let each layer cool off before welding the next layer. If the manganese wing has a wheel riser, the point should be welded sufficiently high so that it will be level with the wing; i.e., 3/16 in. below the manganese wing after grinding. Horizontal cracks are sometimes found in the wide parts of the point near the bottom of the flangeways, which run into the hollow portion under the running surface. Such frogs cannot be repaired successfully unless all the defective metal is removed. This may leave a hole in the bottom of the cavity. The cost of repairing such a frog will be very high and it should not be repaired unless no other frog is available, or the additional life of the frog will justify the welding cost.

Electric Arc Welding, Employing Special Alloy Electrodes, Has More Than Doubled the Life of Many Units of Manganese Trackwork

If desired, such frogs can be successfully welded by placing a slow order on the track or welding the frog out of track. Remove all defective metal by using grinders if possible. If the defects are very deep, they may be cut out with an oxy-acetylene cutting torch. Grind at least ¼ in. off all burned surfaces. If the hole in the bottom of the cavity is small, it can be welded by making each successive layer overlap the edge ⅛ in. until the hole is closed. Do not allow a crater to form on the edge of the hole which might cause a crack. If the hole in the bottom of the cavity is large, short pieces of nickel manganese steel electrodes or cast nickel manganese steel applicator bars may be placed over the hole. Do not use any other kind of steel. Weld over the bars so as to fuse them thoroughly together and into the casting. If the frog is out of track, it should be turned over, ground off and a reinforcement welded.

Grinding the Frogs

Proper care should be given the grinding of frogs after they have been welded. If the frog is welded in track, it should be rough ground and traffic allowed to cold-roll the surface for at least one day before the grinding is finished, if possible. Grind the top surface of the wing opposite the point to a level 3/16 in. higher than the wing rail. Grind off all overflow on the edges of manganese wings so as to provide the standard flangeways for a new frog. Round the corners of the wings to not less than 3/16 in. radius, grind off all overflow on the edge of the point and round the corners of the point to not less than 5/16 in. radius; grind the top surface of the point level with the wing rail or 3/16 in. below the manganese wing if there is not a full 3/16-in. wing riser.

It is essential that the proper voltage and amperage be used in order to obtain proper fusion between the weld metal and the original casting. Various diameters of rods require different amounts of current to produce the proper penetration. The lowest possible current that will give good penetration should be used.

The approximate amount of current for the various sizes of electrodes is as follows:

Diameter of Electrodes	Current
⅛ in.	75 to 100 amps.
5/32 in.	100 to 150 amps.
3/16 in.	125 to 175 amps.
¼ in.	175 to 225 amps.

Rail End Welding

Rail to be welded must be clean, free from dirt, dust, grease, paint or other foreign substances. Use a steel wire brush to secure clean metal. Where laminations, oxidized metal or cracks exist under the rail head surface which cannot be thoroughly removed by the steel wire brush or a chisel, the rail head should be ground down with a grinder to the parent metal so that the weld will be applied to the clean original rail steel.

All chipped or spalled rail ends should be cut or ground down to clean parent metal, welded and ground to a true surface. Rail ends which are cupped and the surface upset, will have the cupped surface built up and the upset portion ground to a true surface.

When rail ends are not battered but when measured, show a difference in height, the high rail should be ground down to the height of the low rail, with the proper run-off, providing

the difference in height between the surfaces of the adjacent rail heads is 1/64 in. or less. If the difference in height is over 1/64 in., the low rail should be built up to the proper height and the weld metal ground to a true surface with the adjacent rail.

In depositing metal on the rail head surface, start the welding bead at the end of the portion of the rail head farthest from the rail end to be welded, and opposite the gage side of the rail head, one-half the width of the head beyond the limit of the weld.

Building Up Battered Frog Points by Gas and Arc Welding Is Common Practice on Most Roads

Deposit a bead with a weaving motion from this point to the rail end, then lay a bead across the rail end, then along the edge of the rail, to the junction of the rail head surface curve and the rail edge fillet curve, then from the end of the rail to a point one-half the width of the rail head from the end of the weld, to secure the proper run-off of the weld for traffic. Bead in solidly longitudinally, then lay a bead diagonally across the rail head, closing in the deposited beads, each bead overlapping the adjacent bead to avoid craters in the deposited metal. The end of the final bead must be terminated in a bead previously laid. Beads must not be broken at the end of the weld but must be turned continuous with the adjacent bead.

It is recommended that all joints welded should be inspected frequently, a record of inspections placed on file, and all indications of lapping or failures reported promptly. One Class I railroad which has been building up rail ends for several years by both the arc welding and gas welding methods, reports that the arc-welded rail ends do not batter down as fast as gas-welded rail ends, but that it was having some trouble with the arc-welded rail ends spauling.

To measure rail end batter to determine the amount of weld place a 24-in. straightedge on edge along the center line of the rail heads, with the center of the straightedge midway between the rail ends, at the center of the joint. The points where the edge of the straightedge rests on the rail head on each side of the rail ends, are the approximate limits of the weld to be made. To check the weld to be made on each rail end, place the 24-in. straightedge on edge along the center of the rail head, with one end even with the edge of the rail to be measured. The limit of weld will be from the point where the top of the rail head is in contact with the lower edge of the straightedge, so applied, farthest from the rail end. Where the rail and metal is upset adjacent to the battered area, the weld should end at the upset portion, nearest the rail end, and the upset portion ground down to a true surface.

The first method mentioned gives the general condition at the joint, but the latter method should be followed strictly to determine the exact limits of the weld. Where a difference in the heights at the rail ends occurs, the work to be done can be ascertained by sliding the 24-in. straightedge along the rail, keeping it in contact with the center of the rail head over the adjacent rail head, until it comes in contact with the rail head surface, which point will be the limit of the weld to be made.

Before any welding is done the joints must be thoroughly tamped and brought to a true surface. Bars must fit snugly throughout, particularly at the center of the top of the bar, with sufficient drawing space between the inside of the bar and the web of the rail. If the inside of the bar engages the web of the rail, or is too close to allow proper drawing space, or does not have a fit at the center of the top of the bar, the bars must be renewed with reformed oversized bars. Bolts must be tightened and, if necessary, must be renewed.

The proper expansion of the rails at the joints must be provided for and maintained to avoid the chipping of the rail ends when the joint is tight under traffic. Joint ties must be renewed when necessary to provide proper joint support. Ballast at joints must be cleaned to provide proper drainage conditions.

Some roads are using arc welding extensively in welding gage plates under frogs and crossings to hold them to proper line. The heavy steel plates, approximately ¾ in. by 6 in., are placed under the crossing, running practically the entire length of the crossties. Square lugs are welded to the steel plates along the outside edge of the lugs. Before welding, the lug is placed tightly against the base edge of the crossing or frog. The steel plates are punched for screw spikes and the plates are spiked to the ties, using approximately 12 screw spikes to each plate. By using the arc welding process for welding these lugs to the frog plates, one can avoid burning the ties underneath the plates.

It is found that the use of steel gage plates under a crossing serves to hold the crossing in line. Some crossings, particularly on curves, get out of line without the use of the frog plates, causing the frog points to break off. By using the gage plates, this trouble has been eliminated.

Welding Wheel Burns by Arc Welding

Briefly, the procedure of building up wheel burns by arc welding is as follows: A portable electric grinder is used to grind out all of the shattered or laminated metal. When the grinder has removed all the laminated metal and has reached good solid metal having the appearance of uniform structure, any laminated or shattered metal will show up under the grinder, either blue or dark. This area should then be preheated to a predetermined temperature with a portable oil-heating torch. Immediately following, the welding, which is very rapid, is applied. The welding is very rapid since only a small amount is needed to fill up the area ground out. The next step is to cover the welded area so that it will cool slowly. The final step is the grinding or finishing of the welded area. A fine grain stone should be used to develop a smooth surface.

Continuous Welded Rail

A considerable amount of rail has been joined together by the use of the electric arc for installation in streets, crossings, station landings and in some open track. It has been the practice in main line track to replace the joints; however, in some locations other than in the main line, the joint bars have been left off. The exact method employed in this process is described fully in the April, 1939, issue of *The Welding Journal* of the

American Welding Society. This process has been very successful, owing to the relatively large number welded, with few failures reported.

Committee—R. L. Fox (chairman), roadmaster, Sou., Alexandria, Va.; G. L. Griggs (vice-chairman), rdm., C. B. & Q., Hannibal, Mo.; W. B. Bailes, supvr., Sou., Charlottesville, Va.; R. H. Carter, div. engr., I. C., Chicago; J. J. Clutz, div. engr., Penna., Indianapolis, Ind.; E. C. Buhrer, supvr., N. Y. C., Sandusky, Ohio; L. M. Denney, supvr., C. C. C. & St. L., Indianapolis, Ind.; H. C. Fox, supvr., Sou., Spartanburg, S.C.; R. H. Gilkey, div. engr., C. of Ga., Savannah, Ga.; W. A. Gunderson, dist. main. engr., C. R. I. & P., El Reno, Okla.; J. C. Jacobs, supvr., I. C., Decatur, Ill.; C. E. Morgan, supt. work equip., C. M. St. P. & P., Chicago; J. Morgan, ret. supvr., C. of Ga., Leeds, Ala.; W. P. Nichols, supvr., C. & O., Riverton, Ky.; D. V. O'Connell, rdm., C. & N. W., Chicago; W. H. Oglesby, supvr., Sou., Camden, S.C.; C. R. Schoenfield, rdm., C. B. & Q., Aurora, Ill.; J. O. Surprenant, rdm., D. & H., Schenectady, N.Y.

Discussion

A prolonged discussion following the presentation of this report showed a distinct difference of opinion as to the practicability and safety of building up switch points in track and of welding driver burns on rail heads to restore the original surface of the rail, several pointing out that both of these practices were common on their roads, while others stated that they were either prohibited or strictly limited. According to President Sitton, his road, the Southern, has welded many switch points in track successfully, and has built up by welding more than 100,000 driver-burned spots without a single failure that could be attributed to the welding work. W. H. Sparks, (C. & O) also spoke of the extensive building up of driver burns on his road, but both L. M. Denney (Big Four) and C. W. Baldridge (A.T. & S.F.) were fearful of the practice and recommended extreme caution in its use.

The proponents of building up driver-burned spots cited the advantages in restoring the running surface of the rails through welding, and while they admitted that the rail at the restored spots was, unquestionably, not as strong as new rail, they contended that the rail at these points was stronger than at driver-burned spots not welded. There was a general feeling, even among those who have practiced the building up of burned spots most extensively, that carefully conducted tests should be made to determine the relative strength of burned rails, built-up burned rails and normal unburned rails.

In another part of the discussion C. C. Pelley (I.C.) and A. Chinn and M. D. Carothers (Alton), described a relatively recent method being used on their roads to take the downward bend or droop out of angle bars in track. This method, they pointed out, involves the spot heating of the bars along the base and lower part of the web near the center, extending over a length of from 2 to 6 in., depending upon the amount of droop, and then relying upon the unequal contraction of the section in cooling to raise the center of the bar. It was pointed out that this practice is not only entirely practical and economical in itself, but that, carried out ahead of rail end welding to remove wheel batter, it naturally shortens the length of the weld and thus reduces the welding cost. It was also brought out that many thousands of joints have been raised by this method during the last year on several roads, with what appears to be complete success.

Slow Orders—Their Use in the Light of Present-Day Operating Conditions

Report of Committee

E. L. Banion
Chairman

SLOW orders of either temporary or permanent form impose restrictions varying in delay and expense with the type and tonnage of trains, tracks, grades and alinements. For many years slow orders have been looked upon as something that no one wanted, but was seldom able to pay the price to avoid. Their use was tolerated as the least expensive method of securing the requisite degree of safety while performing ordinary maintenance work under traffic.

Slow orders are train orders fixing the maximum rate of speed for the movement of trains at certain locations because of the presence of unsafe, unusual or abnormal operating conditions. To be effective, slow orders must be clear and definite as to the location affected, and after they are placed, they must be rigidly enforced. Slow orders whose prospect of observance is doubtful, are worthless and should not be tolerated. Orders reading to "Look out for men working," "Look out for washed track," and similar orders are of little value. If the conditions sketched in such an order are actual, proper steps should be taken to place a slow order restricting the speed of trains at the location affected.

It was formerly considered economical when erecting structures, making heavy renewals, etc., to reduce the speed of all trains at that point to a minimum, rather than to construct temporary tracks or structures that would allow normal or at least reasonably high speeds. Today much delay to trains is avoided by the expenditure of comparatively small amounts of labor to eliminate delays that were formerly considered permissible.

Slow Orders Necessary

In ordinary track maintenance, slow orders can frequently be eliminated, or the length of time that they are in force can be greatly reduced by proper supervision and co-ordination. When slow orders are necessary to protect unsafe conditions, immediate action should be taken to see that the order is removed and the track restored to normal service with the least delay.

While slow orders should not be necessary on a perfect piece of track, we have not yet arrived at that state of maturity in track maintenance. During the last several years of low

earnings and subsequent curtailed maintenance forces, it has been necessary to substitute slow orders for maintenance funds in many instances.

High-Speed Train Operation

Until the time that the "Super-Trains" were placed in high-speed passenger service, slow orders were assumed to be a necessary evil. In this

Slow Orders Today, In the Light of High-Speed Streamlined Trains and Generally Accelerated Freight Service, Assume Much Larger Importance Than Only a Few Years Ago

day of greater train speeds, the one thought is to eliminate delays of all kinds; on this subject all departments are in accord.

It appears that the acme of perfection should be tracks over which high-speed trains can be operated at a uniformly high speed, of say 80 miles an hour, with no slow downs, speed restrictions, or slow orders. Such a speed should meet all present-day demands, and the schedule could be maintained with more comfortable riding trains and less damage to the track structure.

The high-speed super-trains came into operation at a time when general maintenance was near its all-time low. Money for curve revisions and reductions was scarce; for that reason many of our slow orders constitute permanent speed restrictions that must continue in force until business shows a substantial improvement.

On lines handling transcontinental trains, large sums have been spent to eliminate the most restrictive of these permanent slow orders, by reducing and revising curves and grades. However, the outlook for increased business sufficient to make possible the elimination of all slow orders and speed restrictions is remote, making necessary forbearance with many such restrictions for years to come.

Train Delays Are Costly

Delays and slow orders tend to make necessary the further increase in speeds when the way is clear. Short bursts of excessive speed not only create added damage to the track structure and equipment but also cause poor riding track.

Excessive speed in making up lost time causes irregularities in locomotive performance and there are instances where rail on well-maintained track is badly damaged in this way by driver kinks. With the heavier sections, kinked rails frequently require replacement, while on the lighter sections the results are even more hazardous since the terrific impact of the nosing drivers occasionally causes broken rails. Not all these ills can be laid to slow orders, but they are a heavy contributing factor.

Drastic reductions in speed are expensive in high-speed train service; the cost varying with the locomotives, the number of cars, the tonnage, the speed and whether the grades are level, ascending or descending.

The rate of acceleration is slow, above 45 miles per hour, and it is greatly reduced above 60 miles per hour. Trains operating at high speeds require much more power than at medium speeds. Likewise, more power is required to reach a high speed than is required to maintain that speed. Figures are cited of certain trains that require a distance of as much as 30 miles to attain their top speed. Under such circumstances, frequent slow orders or speed restrictions not only cause delays in a hard-to-make schedule, but are likewise costly in terms of energy expended to regain the top speed and may result in total inability to maintain the schedule.

It is difficult to arrive at cost figures that will reflect with any degree of accuracy this actual out-of-pocket expense for high speed trains caused by slow orders. Passenger trains are operating today at scheduled speeds in excess of 80 miles per hour between control points. Such trains are given the right of way over all other traffic and special efforts are made to keep them on schedule. Certainly maintenance forces must render every assistance to this objective.

The accompanying graphical representation of the brake deceleration and train acceleration on level, 0.5 ascending, and 0.5 descending grades, serves to illustrate the time lost when high-speed trains are required to reduce speed in compliance with slow orders. This covers but a train length of slow track; consequently a further length of slow track would increase in elapsed time lost. Several such slow orders on a division or district would result in a delay in the schedule that could not be run off.

Protecting Slow Track

Specific rules govern the action of maintenance men in their use of slow flags and speed restrictions. This is proper because speed restrictions impose action prescribed by the wisdom of experience and tried judgment. Under these rules, it is imperative that maintenance forces govern their practices accordingly, bearing in mind that the safe passage of the train is of paramount importance, and that this must be accomplished with the least delay possible.

Eternal vigilance is the price of

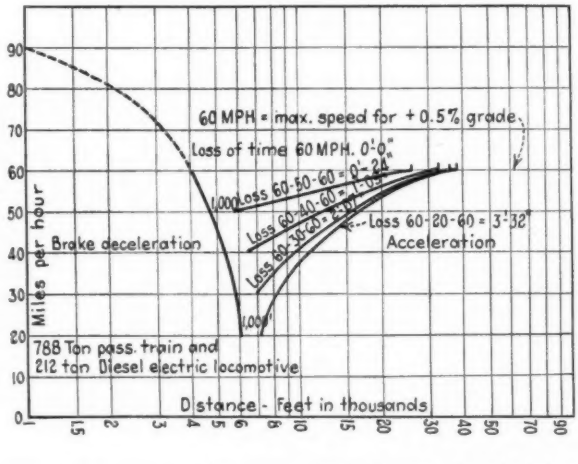


Chart Showing Time Lost By a 788-Ton Passenger Train and 212-Ton Diesel-Electric Locomotive, Decelerating From 60 M.P.H. to Various Speeds, Then Running 1,000 Ft. at These Restricted Speeds, and Then Accelerating Back to 60 M.P.H. —Grade 0.5 Per Cent Ascending

safety; an old adage, but doubly applicable where high-speed train schedules are concerned and it should extend to the prompt removal of slow orders when the restrictive factors are removed. Maintenance officers must be alert in detecting slight irregularities in surface and line of track, particularly in the spirals and super-elevation of curves, and in making prompt repairs before a slow order becomes necessary. When repairs cannot be made quickly, good judgment must determine the highest safe speed possible, and the rough spot covered by a slow order, which should be removed as soon as repairs permit.

Allow Maximum Speed

It should not be necessary for foremen and others, in placing slow orders, to use an unwarranted margin of safety to protect against the possibility of enginemen exceeding the restriction. Slow orders should allow the maximum speed possible, and their strict observance should be assured. Improperly placed slow orders lead to lack of confidence among enginemen and sometimes to total disregard of the order.

Slow orders must be resorted to when seasonal conditions prevent adequate inspection and maintenance of all main line tracks and facilities. In some sections of the country, frost action in ballast causes track to heave over shallow covered pipes, arches, culverts and other track openings. In such instances, slow orders are occasionally necessary until the heave can be shimmed out and the track restored to normal speed. Such places should be carefully watched when the frost goes out of the ballast to avoid rough spots over the shims. In many instances, proper drainage will eliminate the heaving.

In considering heaving track, it should be remembered that not all heaving is caused by the expansive action of ice. A very common cause of slow orders is soft track and the heaving of the sub-soil in fills and embankments, and most frequently in poorly drained cuts. This heaving of the roadbed is seldom found in soil containing a high percentage of sand or pervious material. The most troublesome locations are in certain clays and gumbos, where the impervious character of the soil causes water to be impounded or pocketed beneath the ballast in the sub-surface structure.

Many cures for such ills have been tried successfully. Almost any system of draining the affected location, or of preventing the accumulation of water in the sub-grade, will greatly relieve, if not entirely cure the situation. To avoid slow orders, good drainage is most important.

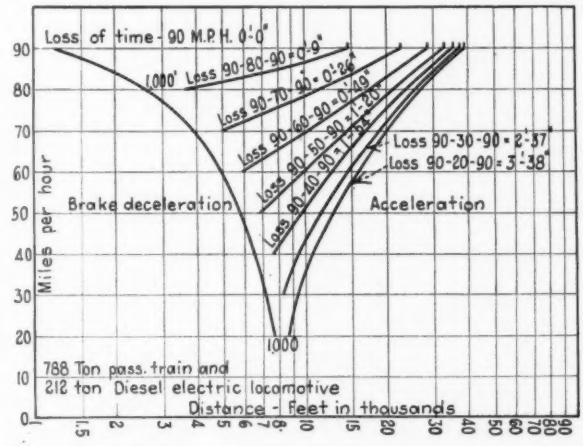


Chart Showing Time Lost by a 788-Ton Passenger Train and 212-Ton Diesel-Electric Locomotive, Decelerating From 90 M.P.H. to Various Speeds, Then Running 1,000 Ft. at These Restricted Speeds, and Then Accelerating Back to 90 M.P.H.—Grade 0.5 Per Cent Descending

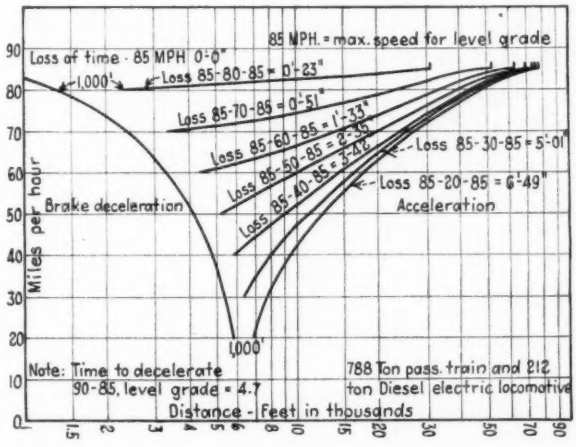


Chart Showing Time Lost by a 788-Ton Passenger Train and 212-Ton Diesel-Electric Locomotive, Decelerating From 85 M.P.H. to Various Speeds, Then Running 1,000 Ft. at These Restricting Speeds, and Then Accelerating Back to 85 M.P.H.—Level Grade

Flagging Instructions

Maintenance of way rules are explicit in their instructions—"When track is unsafe for any reason, a reliable man with flagman's signals will be stationed (the required distance) in each direction from the point of danger. Flagman will display stop signals to all trains approaching point of danger. Flagman must remain until recalled." In multiple-track territory, flagmen must consider each track as a single track railroad upon which trains may be run in either direction, at any time, and place signals accordingly on the engineman's side of the track.

In flag protection there can be no half-way measures. Flagmen must either be instructed to display stop signals or slow signals to all approaching trains, or they should be recalled. It is considered an unsafe practice to instruct flagmen to stop certain trains and allow other favored ones to pass. On some jobs a satisfactory arrangement has been worked out where intermittent flagging is required, by using a telephone between the flagman and foreman. However, there must be a clear understanding between all parties concerned to eliminate any possible confusion.

Temporary Slow Signals

After track has been repaired sufficiently to allow the passage of trains at reduced speed, the stop signals may be removed and slow orders issued to trains. The slow track should be further protected by the use of temporary "slow" and "resume speed" signals, placed at a designated distance in advance of the slow track, and at the point where normal speed may be resumed.

In new work coincident with curve and grade revision, it is evident that much can be done to place the new alinement in service at top speed, rather than following the more common practice of gradually increasing the speed over a period of several months. Present earth-moving and compacting machinery makes this possible. There is small excuse for any allowance for settlement if the earth work is handled in line with modern earth moving standards. The

added expense incurred in such construction is justified, rather than to continue slow orders on the new track for an indefinite period.

When Is Track Unsafe?

In performing certain maintenance of way work, the question frequently arises, "Can this work be performed under slow order protection, or is stop signal protection necessary?" We know that the removal of a single rail from a main track constitutes an unsafe condition, and must be protected with stop signals. In addition, it is the practice on some railroads to set the automatic signals in stop position as an added precaution.

The removal of single ties from track, spotting and lining work and light lifts seldom require slow order or stop-signal protection, as the track need not be made unsafe if proper supervision is given the work. On the other hand, can out-of-face surfacing, with extra gangs using off-track machines and tools, be performed safely under slow order protection? The answer depends on the character of the work involved and the amount of cooperation between the maintenance of way force and the operating department, particularly the observance of train orders by enginemen.

On a ballasting and surfacing program involving light and medium lifts, it is possible to handle the work by using a form slow order. The following form of slow order has been used in such cases and is given here as an example, "Surfacing track between (Station) and (Station), M.P.—and M.P.—, from 7 A. M. to 4 P. M. Approach gang at restricted speed and if proceed signal is given may pass through gang, speed limit 10 miles per hour."

It was found the work could be performed satisfactorily in this manner with small delay to trains, and the delay to the surfacing and ballasting operations was less than if stop signals had been used and the train stopped. The idea is to keep the trains moving and to get them through the gangs with the least possible delay to all concerned.

Telephone operators with portable telephones and in direct communication with the train dispatchers kept the foremen advised of train movements. Foremen were soon able, on receipt of advice of an approaching train, to make a run-off and close the work to allow the train to pass at reduced speed on arrival. The only appreciable delay to the gangs was that occasioned by long trains passing over the work.

With Proper Supervision, Spot Surfacing Need Seldom Make the Track Unsafe and Call for Slow-Order Protection

With this method, the only question of any serious concern is, "When does such gang work create conditions that render track actually unsafe for the passage of trains at slow speed?" It is our conclusion that this work can be carried out without infringing on the fundamental safety factor, or violating rules requiring stop signal protection on unsafe track.

Avoid Train Delays

The use of large mechanized extra gangs for large track work operations will reduce train delays by shortening the duration of the work. The working hours of gangs can often be so changed as to reduce delays by setting up the regularly assigned hours in such a way as to allow preferred scheduled trains to pass prior to opening or after the close of the work. Occasionally it has been found expedient to start gangs at 5 or 6 oclock in the morning during the summer to avoid some such delays.

In multiple-track territories, it is seldom necessary to lay rail under traffic, trains being diverted to other tracks, and the track on which the work is being done being "killed" for a definite period. Under such circumstances, no slow orders are necessary. However, work that renders track unsafe, such as laying rail, does not prevent the use of stop signals, even on "dead" track.

In working on a dead track adjacent to the live track on which the increased volume of traffic is handled, serious consideration must be given to the safety of the men at work. The numerous machines used in present rail laying and surfacing operations makes hearing difficult at best, and extra precaution must be taken to avoid accidents from passing trains.

Orders to trains on the live track are of questionable value if they merely state, "Look out for men working at a given location." It is either necessary for them to reduce their speed approaching and passing the gang, or if this is considered unnecessary, it is advisable to give such trains an order directing that they sound the whistle frequently approaching and passing the gang. Of course, they will sound the "against traffic" signal when so operating. It is seldom necessary to reduce the speed of such movement unless unusual conditions exist.

Temporary slow signals, consisting of yellow flags or yellow discs, and yellow lights, should be placed on the engineman's side of the track in single or multiple-track territory, approximately one mile in advance of the slow track, the face of the sign or slow flag to be set facing the approaching train. Where there is a succession of stretches of slow track and there is not sufficient distance between them for the resumption of normal speed, only one slow sign will be set as specified, preceding the first stretch of slow track. Temporary "resume speed" signals, consisting of a green flag or green disc, and a green light, should be placed at the point where the rear of the train permits normal speed to be resumed.

Temporary restrictive speed and resume-speed signals must be placed on each side of the slow track to locate the restriction properly. Some rules require that with the display of such signals in the absence of slow order, trains must observe a speed of 15 miles per hour, until the resume-speed signal is passed.

Permanent Slow Signals

Permanent slow and resume-speed signals are used where the slow order or restriction is of a permanent nature; the permissive speed is indicated on the face of the sign. Permanent signals are covered by bulletin or notes in the current timetable. Such signals are seldom used to protect temporary slow orders, but rather to locate and incidate the speed permissible at locations where track cannot be maintained for top speed. The most common locations of permanent signals are curves of high degree on which the required super-elevation cannot be maintained for top speed.

It is found that the use, location, wording and numbering of slow signals, differ on various railroads. On

certain roads, permanent speed restrictive signals are installed for normal locomotive-operated trains and special higher rated speed signals are used in addition for Diesel-operated passenger trains.

On some roads, no restrictive signals are used, relying on the engineman's observance of that information placed in the timetable. Other lines contemplate the elimination of that information from the timetable, relying on the uniform placing of speed restriction signals.

It is felt that high-speed train movement makes necessary some uniform system of imparting this information to the enginemen at the point it is needed. A mistake in making the proper deceleration at some locations may prove disastrous, particularly at the greatly increased speeds of today.

Protecting Bunk Cars

Speed restrictions are not considered necessary in passing occupied bunk cars on adjoining tracks. "Live" bunk cars set out should be protected by derails placed on each side of the cars, or the switch should be spiked or locked with a private lock, or other suitable means should be employed to prevent accident to the occupants.

Some Classes of Work, Such as Ballasting and Surfacing Out-of-Face, Require Slow-Order Protection for Safety, But Should Be Handled to Avoid Stopping Trains

Roadway equipment of "off track" design, when working in close proximity to a main track, where it may foul the track, should be protected by stop signals or train order directing that train movements be governed by hand signals at the point where the work is being performed. Other machines operating "on track" are protected by train orders and operate under train service rules.

In conclusion, present-day high-speed train schedules in both passenger and freight service, demand that slow orders be kept to a minimum at all times if these schedules are to be maintained. The fact must not be overlooked that such high speeds must be safeguarded by a correspondingly higher degree of maintenance, better supervision, closer co-operation and better equipment.

At locations where physical conditions will not safely permit top speed, permanent slow signals must be maintained, and slow orders must always be resorted to as a means of insuring the safe passage of trains.

Since slow orders are occasionally necessary, conscientious observance by enginemen must be insisted upon rigidly—strict observance demanded and secured by frequent tests; employing discipline when required. There should be no tolerance.

Committee—E. L. Banion (chairman), rdm., A. T. & S. F., Marceline, Mo.; E. J. Brown (vice-chairman), dist. engr. m. w., C. B. & Q., Galesburg, Ill.; M. R. Black, supv., L. & N., Etowah, Tenn.; E. G. Brisbin, supv., Mich. Cent., Jackson, Mich.; J. F. Beaver, supv., Southern, Durham, N. C.; M. H. Dick, eastern ed., *Railway Engineering and Maintenance*, New York; H. E. Kirby, asst. engr., C. & O., Richmond, Va.; J. D. McSheffrey, rdm., C. P. R., Prescott, Ont.; R. E. Meyer, rdm., C. & N. W., Mason City, Iowa; E. M. Pelter, asst. rdm., Southern, Somerset, Ky.; E. L. Potarf, asst. supt., C. B. & Q., Sterling, Colo.; W. C. Radford, supv., Southern, Chester, S. C.; R. L. Sims, asst. supt., C. B. & Q., Wymore, Neb.; T. N. Turner, rdm., M. P., Newport, Ark.

Discussion

Armstrong Chinn (Alton) emphasized the importance of watching for and correcting promptly slight irregularities in high-speed tracks, reminding his listeners that the impacts of equipment vary approximately as the square of the speed and pointing out, for example, that in increasing the speed 40 per cent, the effect of irregularities is increased approximately 100 per cent. Continuing, he condemned the practice of many foremen, supervisors and roadmasters of placing unduly restrictive slow orders on track, with the thought that they must guard against carelessness or disregard on the part of enginemen. On the contrary, he said that roadmasters and their subordinate officers should know what speed the track is safe for and should place orders accordingly, reporting any violations on the part of enginemen to insure their compliance and respect.

Commenting upon that part of the report relating to the necessity for slow orders where track heaves due to frost action, Mr. Chinn described a method that he has employed effectively to minimize heaving at points where this has been a specially difficult problem. This, he said, involves the cribbing out of the ballast to the bottom of the ties, placing approximately three inches of salt in each crib, and then backfilling with the ballast removed, relying upon the salt to lower the freezing point of the moisture in the roadbed to the point where it is not serious.

President Sitton seconded the comments of Mr. Chinn relative to too restrictive slow orders, citing an example of a 15 m.p.h. order on a long section of track which was safe for a speed of 40 m.p.h., causing unwarranted delays to trains.

W. H. Sparks (C. & O.) emphasized the great responsibility that rests upon those who must determine the proper speeds at which it is safe to run trains over weakened track, pointing out that since no set of rules can be developed that will cover all conditions, the placing of slow orders requires the exercise of the keenest judgment.

At this point the discussion turned to the construction of detour or shoofly tracks around construction projects, especially highway-railroad grade separations, it being brought out that there is now a marked general tendency to construct these for much higher speeds than formerly. Mr. Chinn said that whereas speed restrictions of 10 m.p.h. on shooflies had been the rule on his road in years past, this had been increased to 40 m.p.h. in many instances in recent years and that he now contemplates the construction of a shoofly that will permit a speed of 60 m.p.h. He estimated that through the increased speed now permitted at many construction projects, delays to trains of from three to five minutes are prevented.

G. L. Morrison (S.P.) said that his road had held out with highway commissions for detours having maximum curvature of 4 deg., but that the best they were able to get was a maximum of 5 deg., which called for a speed restriction of 50 m.p.h. E. J. Haley (A.C.L.) said that it was now the policy of his road to construct all shooflies on both main and branch lines for the normal train speeds in the territory involved, eliminating all delays to trains.

No one had figures available to show the increased cost for the higher standards of shoofly construction required for the higher speeds but it was the consensus that in most cases this would not be excessive and would be fully justified where important trains or heavy traffic were involved.

The Track Supply Association Presents Large Exhibit

R. J. McComb
President

Lewis Thomas
Secretary-Treasurer

WHILE the Track Supply Association as it exists today is by no means as old as the Roadmasters Association, the idea of exhibiting tools and materials required for track construction and maintenance originated at the second annual convention held at Indianapolis, Ind., in 1884. It is of special interest that similar exhibits have been presented at every succeeding convention except two, these being at Chicago and St. Louis in 1893 and 1904 respectively, and it is not going too far to say that, particularly in late years, the exhibit has been an important element in the success of the conventions.

Indicating a wholesome response to the increased activity in all branches of railway maintenance during the year, 55 manufacturers of materials and equipment used in track maintenance presented exhibits, requiring 75 exhibit spaces, compared with 45 companies and 63 exhibit spaces last year. Five of these companies presented exhibits before the roadmasters for the first time, while six had not exhibited for several years.

The officers of the Track Supply Association who were responsible for the planning, preparation and conduct of the exhibit this year were, president, R. J. McComb, vice-president, Woodings-Verona Tool Works, Chicago; first vice-president, E. C. Argust, vice-president and secretary, Morden Frog & Crossing Works, Chicago; second vice-president, R. M. Blackburn, Buda Company, Chicago; secretary-treasurer, Lewis Thomas, general sales manager, Q & C Company, Chicago; directors, Lem Adams, vice-president, Oxweld Railroad Service Company, Chicago (ex-officio); G. L. Sitton, Southern Railway, Charlotte, N.C. (honorary); F. P. Cullen, Cullen-Friestedt Company, Chicago; W. W. Fitzpatrick, Nordberg Manufacturing Company, Chicago; H. C. Hickey, The Rail Joint Company, Inc., Chicago; George Morrow, Reade Manufacturing Company, Inc., Chicago; F. H. Philbrick, Power Ballaster Corporation, Chicago; and J. C. Rinehart, Eagle Grinding Wheel Company, Chicago.

In the election of officers for the ensuing year, Mr. Argust was advanced to the presidency; Mr. Blackburn was made first vice-president; Mr. Hickey was elected second vice-president and Mr. Thomas was re-elected. Directors elected for two years were H. W. Cutshall, Electric Tamper & Equipment Company, Chicago; H. M. McFarlane, O. F. Jordan Company, East Chicago, Ind.; and T. D. Crowley, Creepcheck Company, Chicago.

A list of the exhibitors, together with their products on exhibit and their representatives, follow:

Exhibiting Members

Air Reduction Sales Company, New York—welding and cutting equipment; oxygen and acetylene regulators; pipe welding; rail cropping; butt-welded rail; built-up rail joints; flame-cleaning torch —C. B. Armstrong, A. W. Brown, C. A. Daley, J. F. Franzen, J. W. Kenefic, L. C. McDowell, U. F. Portell; D. N. Newland, E. F. Turner and M. M. Weist.

American Fork & Hoe Company, Cleveland, Ohio—rail anchors; tapered rail joint shims; shovels; weed cutters; ballast forks; rakes; scuffle hoes; broom rakes; axes; hammers; scythes—H. C. Branahl, C. C. Connolly, G. L. Dunn, S. L. Henderson, H. S. Johnson, J. J. Nolan, D. L. O'Brien, Frank J. Reagan, John Skeel and R. J. Whalen.

Armco Railroad Sales Company, Middletown, Ohio—samples of pipe and interlocked and clip-type sheet piling; models of bin-type retaining wall, multiplate pipe and portable airline; subdrainage photographs—C. H. Anderson, R. Y. Barham and E. Harbeck.

Barco Manufacturing Company, Chicago—gasoline tie tampers; gasoline hammer—F. N. Bard, W. J. Belhke, C. A. Cox, C. O. Jenista, W. T. Jones, L. J. Lytle, J. L. McLean, C. L. Mellor and F. B. Nugent.

Buda Company, Harvey, Ill.—inspection motor car; switch stand; bonding drill; track drill; track liner; rail bender; journal jacks; track jacks; hydraulic jacks; pole jacks; tie puller; and tie spacers—R. M. Blackburn, H. H. Cohenour, J. S. Dempsey, R. B. Fisher, F. L. Gormley, W. H. Haas, R. K. Mangan, M. S. Rotroff, J. W. Sanford and G. A. Secor.

Chicago Pneumatic Tool Company, New York—pneumatic tamper; gasoline tamper; and power-vane impact wrench—H. R. Deubel, T. P. Harris, W. Pallowick and W. E. Stockwell.

Chipman Chemical Company, Inc., Bound Brook, N.J.—weed killer and paint products—C. M. Bernuth, N. J. Leavitt, W. H. Moyer, I. J. Strain and J. A. Williams.

Conley Frog & Switch Company, Memphis, Tenn.—expansion joints for fixed span, swing and bascule bridges; solid manganese spring frogs; turntable frogs; frogs for rail laying work and wrecking service—E. H. Baumgarten, J. E. Conley and L. J. White.

Creepcheck Company, Inc., Newark, N.J.—rail anchors—T. D. Crowley, R. R. Dinklage and N. A. Howell.

Crerar, Adams & Co., Chicago—track and bonding drills; track tools; wrenches; handles and track gages; tie, lumber and carpenters' crayons; branding and soldering blowtorches—R. W. Beasant, Geo. J. Doyle, A. Kopala, I. E. Poehler and J. M. Temple.

Cullen-Friestedt Company, Chicago—moving pictures of Burro locomotive crane in operation; rail tongs—W. C. Bamber, K. J. Beller, L. B. Bertaux, C. J. Bronez, E. V. Cullen, F. J. Cullen, F. P. Cullen, T. G. Frazee, G. H. Goodell, Robert W. Jamison, F. L. Kendig, Jos. F. Leonard, James E. Simkins and Wm. J. Roehl.

A. P. deSanno & Son, Inc., Philadelphia, Pa.—radiac grinding wheels—L. G. Martin, A. E. Peterson, P. M. McCance, E. J. Rohan and W. K. Whelan.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.—track jacks; power jacks; journal jacks; automatic lowering jacks; tie spacers; tie remover—C. N. Thulin and E. E. Thulin.

Eagle Grinding Wheel Company, Chicago—grinding wheels—John Abram, L.

E. Buckingham, R. S. Lloyd and J. C. Rinehart.

Elastic Rail Spike Corporation, New York—elastic rail spikes—C. M. Bernuth, William A. Fisher, A. C. Jack and B. Kuckuck.

Electric Tamper & Equipment Company, Ludington, Mich.—electric tie tampers; 1, 2, 4, 8 and 12-tool power units; tamping tools; and assorted blades—H. W. Cutshall, L. S. Osborn, G. L. Walters, J. M. Webb and M. S. Westlund.

Fairmont Railway Motors, Inc., Fairmont, Minn.—inspection car; section car; and extra-gang bridge and building car—C. P. Benning, W. D. Brooks, Kenneth Cavins, W. G. Day, Arthur R. Fletcher, W. F. Kasper, J. T. McMahon, V. Pagett, H. W. Protzeller, C. L. Rager, W. H. Ripken, H. A. Sly, Ira Sublett and William Williamson.

Gary Screw & Bolt Company, Pittsburgh, Pa.—giant-grip dowels; double-grip spikes; dowel studs; and bolts, nuts and rivets—R. W. Dierker, G. J. Garvey, H. C. Graham, M. G. Kirk, P. Robinson and J. J. Schneider, Jr.

Hayes Track Appliance Company, Richmond, Ind.—models of bumping post, derails and wheel stops—S. W. Hayes, S. W. Hayes, Jr., Herbert J. Mayer and John H. Sullivan.

Illinois Malleable Iron Company, Railroad Division, Chicago—rail anchors—Chas. G. Ericson, Dayton T. Hogg, John C. Kuhns and H. A. Morean.

Ingersoll-Rand Company, New York—spot tamper compressor; screw spike driver; rail drill; grinder; wood borer; impact wrench; track wrench; tie tamper; spike driver; and cribbing fork—G. E. Bridge and K. I. Thompson.

Jacobsen Manufacturing Company, Racine, Wis.—motor scythe; power lawn mower; hand lawn mower; power-operated snow plow—L. A. Ferguson, R. B. Hill and A. H. Roper.

O. F. Jordan Company, East Chicago, Ind.—model and pictures of spreader ditcher—A. W. Banton, J. C. Forbes, H. M. McFarlane and C. W. Shipley.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.—one-man inspection car; light section motor car; signal-maintainer car; motor-car wheels; and track gage and level—L. Boswell, Ralph E. Keller, Frank E. McAllister, E. C. Poehler and P. J. Robischung.

Link-Belt-Speeder Corporation, Chicago—photograph of shovels and locomotive cranes—L. P. Spillan and N. A. Weston.

Lundie Engineering Corporation, New York—rail clips; tie plates; and tie tongs—L. B. Armstrong and O. W. Youngquist.

Maintenance Equipment Company, Chicago—switch-point protector; rail and flange lubricator; derail; and literature on rail layer—E. Overmier, T. E. Rodman, R. J. Shanahan and P. A. Wells.

Mall Tool Company, Chicago—gasoline and electric rail grinders; cross slotters; concrete vibrators and surfacers; bridge and building machines; gasoline, electric and air-driven chain saws; gasoline and electric drills; power wrenches; flexible-shaft grinders and polishers—J. Innes, A. W. Mall, F. A. McGonigle, M. Rhenquist and M. Riley.

Metal & Thermit Corporation, New York—thermit-pressure rail welds and electric welding rods—A. Lucas, W. B. Sharav and C. D. Young.

Morden Frog & Crossing Works, Chicago—heat-treated forged compromise joints; adjustable rail braces; forged-steel braces; Sampson switch point; standard switch point; new saw-toothed adjustment for adjustable braces—E. C. Argust, W. Homer Hartz, G. F. Killmer, L. I. Martin and L. C. Reebs.

Moto-Mower Company, Chicago—power sickle-bar mower; power lawn mowers; and hand mowers—L. C. Meskimen, J. O. Spottswood and Mrs. L. C. Meskimen.

Nordberg Manufacturing Company, Milwaukee, Wis.—rail grinders; track power drill; power track wrench; utility rail grinders; surface grinders; precision grinders; accessories—C. P. Clemmens, W. W. Fitzpatrick, C. K. Jensch, H. H. Talboys and W. E. Bugbee.

Northwestern Motor Company, Eau Claire, Wis.—bridge-and-building gang car; all-service section car; safety-first section car; light all-service car—F. W. Anderson, Otis B. Duncan, Geo. H. Goodell, C. E. Murphy, A. H. Nelson, Geo. Prest and W. J. Roehl.

Oliver Iron & Steel Corporation, Pittsburgh, Pa.—gage rods; heat-treated track and switch bolts; screw spikes; drive spikes; and wrenchtite nuts—B. J. Beck, J. G. Graham and John R. Olsen.

Oxweld Railroad Service Company, Chicago—oxy-acetylene welding and cutting apparatus; oxygen; acetylene; carbide; actual examples of battered joint reconditioning; rail butt welding; angle-bar welding; switch-point welding; frog welding; application of switch-point protectors; and heat-treating of rail ends—Lem Adams, D. Arnold, M. C. Beymer, G. P. Bogert, M. Burnett, Jr., W. E. Campbell, F. J. Duffie, F. M. Finsthwait, H. V. Gigandet, E. B. Hall, Jr., F. C. Hasse, R. A. Heaney, H. W. Hicks, W. A. Hogan, S. B. Hopkins, P. Hunter, Jr., J. W. Lacey, Wm. Leighton, G. B. Moynahan, D. H. Pittman, J. H. Rodger, H. W. Schulze, J. C. Stephenson, F. C. Teichen and J. E. Winslow.

P & M Company, Chicago—rail anti-creepers; bond-wire protectors; and tie plate assemblies—J. L. Grant, D. T. Hallberg, P. H. Hamilton, G. E. Johnson, J. E. Mahoney, W. A. Maxwell, F. A. Preston and G. T. Willard.

Pettibone Mulliken Corporation, Chicago—mechanical switchman; switch stands—W. A. Enstrom, E. J. Fallon, C. A. Johnson, Carl Landberg, W. E. Olds and G. J. Slibeck.

Pocket List of Railroad Officials, New York—copies of Pocket List of Railroad Officials—B. J. Wilson.

Portable Equipment Company, Chicago—moving picture of Firestone rubber tie plate and other insulating plates for rails—J. E. Buckingham, T. W. Stedman, S. A. Stephens and A. W. Donop.

Positive Rail Anchor Company, Chicago—rail anchors; guard-rail plates and braces; adjustable rail braces—L. C. Ferguson and R. J. Platt.

Power Ballaster Company, Chicago—motion pictures of power track ballaster and power track cribbing machines—W. E. Bugbee, Ralph Payne, F. H. Philbrick, L. L. Schreck and Stanley H. Smith.

Q & C Company, New York—guard-rail clamp; switch-point guard; compromise joints; derail; gaging tools; wheel stops; rail tongs; gage rods; flangeway guard; adjustable rail brace; electric switch heater—G. H. Goodell, M. Iseldyke, L. E. Hassman, G. Prest and Lewis Thomas.

The Rail Joint Company, Inc., New York—insulated rail joints; standard joints; compromise joints; and fibre insulation; RMC plastic cakes for joint lubrication—W. E. Gadd, Harry C. Hickey, H. L. Lansing, G. H. Larson, J. N. Meade, R. W. Payne and Thomas Ryan.

The Rails Company, New Haven, Conn. M. & L. track; compression track fastenings; compression screw spike; full-throated cut spike; oil, gas and electric switch heaters; track lubricator; spring spike; head-contact insert for reconditioning of rail joints; automatic switch lock; poster on strip welding for building up battered rail ends—R. E. Bell, L. T. Burwell, W. A. Peck and J. V. Wescott.

Railway Engineering and Maintenance, Chicago—copies of Railway Engineering and Maintenance and Railway Age—G. E. Boyd, C. M. Burpee, S. W. Hickey, N. D. Howard, Elmer T. Howson, F. C. Koch, H. E. McCandless, C. W. Merriken, H. A. Morrison and J. S. Vreeland.

Railway Purchases and Stores, Chicago—copies of publication—K. F. Sheeran and Edward Wray.

Ramapo Ajax Division, American Brake Shoe & Foundry Company, New York—switch stands; rail lubricators—T. E. Akers, G. A. Carlson, J. E. Davidson, R. E. Einstein, H. Hazelton, A. F. Hess, Darcy F. Hilton, J. V. Houston, A. F. Huber, J. S. Hutchins, J. P. Kleinkort, E. F. Needham, R. W. Payne, W. A. Peddle, H. W. Renick.

Railway Track-Work Company, Philadelphia, Pa.—portable track grinders; stock-rail grinders; flexible-shaft grinders; portable drill; accessories; grinding wheels—H. M. Moorhead and A. M. Nardini.

Reade Manufacturing Company, Inc., Jersey City, N.J.—literature and photographs on weed control—D. M. DeWitt, George Morrow, C. A. Parish, Charles H. Reade and Charles F. Reade.

Templeton, Kenly & Co., Ltd., Chicago—track, bridge and journal jacks, with exclusive wheel hold-down; car-retarder jacks; tie spacer; rail puller and expander—W. C. Cornu, H. C. Dilsizian, R. B. Hill, W. H. Kreer, P. H. McManus, William Simpson, J. B. Templeton and W. B. Templeton.

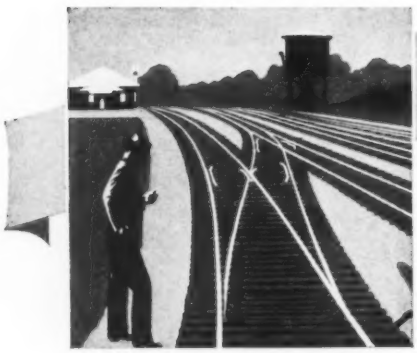
Union Switch & Signal Company, Swissvale, Pa.—showing hand operated switch stands with lock-rod circuit-controller and point detector; transparancies of car retarders and centralized traffic control; U-R interlocking; cab signals; and facing-point lock—W. H. Horsch, J. L. Loucks, J. K. Mickley and George Marloff.

Warren Tool Corporation, Warren, Ohio—Flex-Toe claw bar—W. H. Bon, F. J. Lehman, Howard Mull and O. W. Youngquist.

Western Railroad Supply Company, Chicago—dragging equipment detector; portable wayside device to check train speeds; and various types of lamps—John Hensel and Norman Gort.

Woodings-Verona Tool Works and Woodings Forge & Tool Company, Verona, Pa.—rail anchors; triflex springs—A. C. Laesing, James McComb, R. J. McComb, G. L. McKewin, J. M. Moore, C. L. Woodings and W. H. Woodings.

Woolery Machine Company, Minneapolis, Minn.—tie cutting machine; creosote-spray machine—A. J. Franke, A. C. Heath and H. E. Woolery.



WHAT'S the Answer?

How Many Ties Per Man-Hour?

When renewing ties without giving the track a general surface, how many ties should be inserted per man-hour in stone ballast? In gravel? When giving the track a lift of 2 in.?

Shows Gang Organization

By W. H. Brameld
Assistant to Chief Engineer Maintenance of Way, Erie, Cleveland, Ohio

Where the track is not to be given a general surfacing, our gangs engaged in the renewal of ties on main lines and, so far as practicable, on branch lines and in yards, consist of a foreman and three men. These men work in pairs, each pair being equipped with 1 clawbar, 1 spike maul, 2 ballast forks, 1 shovel, 2 track jacks, 1 pick, 1 pair of tie tongs and 1 track gage.

One man at each rail removes the spikes from the tie that is to be replaced. Each man then cleans out one-half of the tie crib on one side of the tie, after which the track jacks are placed, one under each rail, lifting the rails only enough to permit the tie to be shoved off its bed into the cleared crib. On double track the man on the outside pulls out the old tie with the tongs. On single track or inside tracks, either man removes the tie as may be most convenient. Both men then proceed to prepare the roadbed for the new tie, after which the jacks are dropped and left standing, and the new tie is inserted.

As soon as the tamping is completed, the rail is raised again, the tie plates are applied and the jacks are removed. While one man is spiking the rail to gage on the new tie, the other one proceeds to fill the crib and dress the shoulder to standard. Where necessary, the ballast removed from the crib is cleaned before being replaced. At the end of the day's work the old ties are piled and burned.

Under the method outlined, in stone ballast the man-hours were 0.70 per tie in 1939, and in cinder ballast, they were 0.51. Where the track is given a general surfacing, with a lift, and the ballast is cleaned, 0.20 man-hours are required for the renewal of a tie.

Depends on Many Factors

By C. H. R. Howe
Cost Engineer, Chesapeake & Ohio, Richmond, Va.

Obviously, the time required to install any individual tie will depend on climate, traffic, density, quality of labor, character and condition of the ballast, and various other local conditions. Since all of these conditions will be averaged if a large number of ties in various localities are considered, perhaps the best answer to the question will be recorded data representing a considerable period. The accompanying table, covering six years of main-line tie renewals, speaks for itself.

Man-Hours to Insert One Tie

Ballast	Method	Number of ties involved	Ties inserted per man-hour	Ties renewed per man-hour*
Stone	Dug in	242,532	0.99	0.86
	Raised	475,350	2.053	1.54
Gravel	Dug in	187,582	1.205	1.01
	Raised	157,992	2.403	1.73

*Includes, in addition to inserting, unloading, piling, trucking and disposing of old ties.

The stone-ballast section extends across the coastal plain, over the Blue Ridge and Allegheny mountains

Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.

To Be Answered in December

1. *Should second-hand bolts and spikes be reused in main tracks? If so, to what extent is this permissible? If not, why?*
2. *What are the relative merits of the various patterns to which brick is laid in station platforms?*
3. *Is it practicable to fix the interval between the shoppings of motor cars? Why? What determines the interval?*
4. *What emergency stocks of bridge materials should be carried? Where should they be located? Who should be responsible for them? How should they be handled?*
5. *What is the most practical and economical type of flanger signs? Why? When and how should they be erected? How and where should they be stored in the summer?*
6. *To what extent should division organizations be advised of the stock of water-service materials carried at district and general storehouses? What are the advantages?*
7. *What are the principle requirements of a satisfactory highway crossing? Which types meet these requirements?*
8. *To what extent can second-hand material be used in building construction and maintenance? What are the advantages and disadvantages?*

to the Ohio river; and the gravel ballast is on a line from the Ohio river to the Great Lakes.

Ballast Should Be Clean

By J. B. Bragg
Section Foreman, Chesapeake & Ohio, Prince, W. Va.

If the track is in good condition and the ballast is clean, one should be able to insert one tie per man-hour in stone ballast. If, however, the ballast is dirty, or the gage is poor so that considerable adzing of the old ties is necessary to bring it back to standard in order that the new ties will be in gage, at least two man-hours to the tie will be necessary. Ties can be installed in much less time in gravel; in fact, at the rate of two ties to the man-hour where conditions are best. If the track is to be raised, about twice as many ties can be installed, compared with digging them in.

Gives Men Tie Allowance

By J. L. Monk
Section Foreman, Southern Pacific, Tombstone, Ariz.

While numerous factors affect the time required to renew a tie, and while there is a rather wide range in the man-hours involved, the average should vary only slightly, even in different localities, except as it is affected by temperature and the effectiveness of labor, for hot weather certainly cuts down on the number of ties that can be handled. I have made it a practice to give every man in the gang a tie allowance for the day, varying this with the conditions of the time and place.

In this way, starting with the tie lying at the point of renewal one man can renew 10 ties in gravel during an 8-hr. shift, including tamping, the replacement of tie plates, spiking and dressing the ballast. If the track is raised 2 in., one man should be able to install 20 ties, although if the ballast is stone, the work will be slower by about 20 to 25 per cent.

Must Include All Work

By W. H. King
Section Foreman, Missouri Pacific Lines, Francitas, Tex.

Since the renewal of ties involves every operation from unloading the new ties to the disposal of the old ones, the number that can be renewed per man-hour will vary between rather wide limits under different conditions, and to get an accurate idea of the man-hours required one should take the mean of a large number of ties renewed at various points. It is difficult to remove ties in stone ballast and one tie per man-hour, after the new tie is on the ground, is about all that can be expected. If the track is being raised, however, this will increase to 2½ ties per man-hour, unless the ballast is exceptionally dirty.

Again, starting with the new tie at the point of renewal, 1¾ ties can be inserted in gravel ballast, including the return of the ballast to the cribs and the disposal of the old ties, while if the track is raised three ties can be inserted per man-hour. This includes the removal of the old tie, inserting, spiking and tamping the new tie, and disposal of the old ties, but not the dressing of the ballast, which should be a part of the surfacing operation.

Transporting Carpenter Gangs

Under what conditions is it more economical for bridge and building gangs to travel to and from work on motor cars or motor trucks than to assign outfit cars for their use? What factors tend to influence this economy?

Both Have Advantages

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

There will be both advantages and disadvantages in any method that may be chosen for transporting or accommodating bridge and building gangs to and from their work or at the site of the work. This magnitude will be influenced in large measure by whether the line is single or multiple track; the density and speed of traffic; the schedules of local trains; the number, size and type of structures to be maintained; the number of gangs employed on the district or division under consideration; the proximity of highways, the traffic they carry and the distances the trucks must be operated from headquarters. All of these factors must be considered before one can determine whether it is more economical for bridge and building gangs to travel to and from work on motor cars or motor trucks, or to assign outfit cars for their use.

For many years boarding and outfit cars have been used for housing bridge and building gangs, their supplies and equipment, so that they could be kept at points convenient to their work. This has long been considered necessary to the economical prosecution of this class of work, since it eliminated much lost travel time. During recent years, however, such radical changes have taken place in train schedules that not a few lines have so infrequent local freight service, and in some cases none, that there is no chance to get outfit cars moved. Likewise, since some of these lines are now given over almost entirely to high-speed trains, it is hazardous to attempt the operation of motor cars carrying large gangs or hauling trailers. In such cases, the motor truck seems necessary; yet, based on the actual cost of operation there is no economy in this mode of transportation, compared with boarding camps and outfit cars, primarily because on the lines in question the highway haul is too great and the ratio of travel time to work time is too high. With headquarters at junction points, and with lines radiating in several directions, the economy of highway transportation would be satisfactory, provided the extreme points to be reached do not exceed an hour's travel time, say 25 to 30 miles from the junction.

Water service gangs can profit more than bridge and building gangs through the use of motor trucks, because they more often are called out on emergency service, at hours when train service is not available. Motor trucks are also economical for paint gangs that work progressively from station to station. The important factors to be considered are the saving in the time of the gang in moving to and from work, the probability of accidents and interference with traffic.

Trips Are Short

By G. A. Rodman
General Supervisor of Bridges and Buildings, New York, New Haven & Hartford, New Haven, Conn.

Our road is located in an area having a high density of population, and is quite compact, being made up of comparatively short lines, with shop headquarters so located that, with few exceptions, it is necessary for any gang to travel less than 30 miles to reach the site of its work. We have two floating bridge gangs to

cover outlying lines that cannot be reached conveniently by the permanently located gangs. We also employ a few floating paint gangs during the summer, housing them in boarding and outfit cars.

Under these conditions, with travel time averaging from one-half to three-fourths of an hour between headquarters and jobs, motor truck transportation is far more economical than boarding cars, with board allowance and all of the expenses incidental to maintaining the cars. Furthermore, since most of the men can live at home, they are much better satisfied with truck transportation than with boarding cars. Another advantage of the motor trucks is that the foreman is able to confer with his superior officer every day, and can take from headquarters such special tools and supplies as may be needed from day to day. Since these tools and supplies can be pooled for several gangs, this arrangement saves the carrying of a much larger stock in outfit cars to meet special requirements or emergency needs.

When a job of considerable magnitude is to be undertaken, a study should be made to determine which method will give the maximum working hours at minimum expense, taking into account all of the costs entering into the operation of both the motor trucks and motor cars. While the boarding cars may allow full working time on the job, it is sometimes necessary to set the cars on a siding some distance from the work, thus making it necessary for the men to walk between the cars and the job four times a day, and this may easily cut down the working time by two hours.

Where boarding cars are used, the number of men available is limited to the sleeping accommodations; with truck operation it is easy to send out a few additional men when they are needed. It is also necessary to provide some way for bringing men housed in outfit cars home for week ends, and in many cases this means a material loss of time. Furthermore, in moving cars from one job to another, the men must be provided with independent transportation and again may lose considerable time between jobs. Furthermore, the question of a good water supply, as well as sewage and garbage disposal, may create a serious problem in the vicinity of cities and large towns. Taking all of these items into account, I am convinced that truck operation is far more economical and satisfactory for the transportation of bridge and building gangs, provided the travel time is not more than an hour each way from headquarters.

How to Support Circle Rails

Should the circle rail of a turntable be supported directly on the concrete or on wood ties? Why? What type of fastenings should be used?

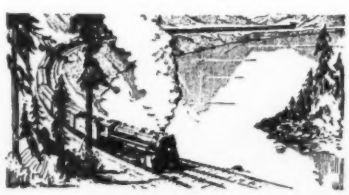
Must Be Held Rigidly

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Turntables are very important structures, as every one connected with the operating department is fully aware. Because any failure of a turntable may be reflected in serious delays to trains, it is imperative that the most dependable form of construction be followed in making the installation. If the circle rail is not supported properly or held in line so that the truck wheels will follow it, there is grave danger of tying up traffic.

It is my experience that where circle rails are supported directly on the concrete there is considerable trouble from broken rails, as well as movement out of line, primarily because of inability to make repairs that will insure that the rail will be held in place. For this reason, it is our practice to use preframed treated ties, 8 in. by 8 in. in section, placing them on approximately 12-in. centers. These ties are laid radially and are supported on a shelf on the wall of the turntable pit, and the spaces between the ties are filled with concrete to a height about 1 in. below the tops of the ties. We use single-shoulder tie plates and hold the rail down with ordinary cut spikes.

In turn, the ties are anchored to the concrete foundation by means of bolts. This plan holds them securely, but makes it easy to remove them when renewal becomes necessary. The concrete, which comes up to about 1⅝ in. below the base of the rail, is sloped toward the center of the pit for drainage. This construction has been quite satisfactory.



Use a Heavy Rail

By H. Austill
Chief Engineer, Mobile & Ohio, St. Louis, Mo.

It has been my experience that a heavy rail, say 130 or 131 lb., correctly curved by machine and supported on steel bearing plates that have been bedded solidly into the concrete foundation, makes the best circle rail that can be found. In this construction the rail is held by clips which are fastened to anchor bolts that pass through the bearing plates. Probably the most annoying and troublesome thing about a turntable is a circle rail that is out of level. The pounding a circle rail receives at the point in line with the lead track is quite severe and the foundation under this point should be unyielding; the circle rail should be installed so that there will be no joint at this point.

When wood ties support the circle rail, they soon wear down where they receive the pounding of oncoming locomotives, and the rail becomes out of level at this point. If wood ties are bedded into the concrete they soon break it up through expansion and contraction. Where they are used without being bedded into the concrete it is difficult to keep the rail level, for fine material works under some of the ties, and some are softer than others, so that low spots soon develop in the circle rail, and the period of trouble has begun.

Keep in Place

By General Inspector of Buildings

I know of nothing that can give more trouble and annoyance than a circle rail that is not kept in good surface, that gets out of line or that is fastened insecurely. A turntable circle rail is subjected to the severest sort of service, and this should be recognized in its design and construction. I do not mean to be critical, but it is a fact that most turntables have been designed by men who are not intimately familiar with their operation, and while, in general, they have done a splendid job with respect to the turntable itself, in many cases they have left much to be desired when it comes to the circle rail.

Considering the large locomotives that must go over a modern turntable, I think that the day of the wood

tie under the rail is past. I would never allow the rail to rest directly on the concrete, for to do so is to invite trouble, which will begin almost as soon as the table is placed in service and which will grow progressively worse, for the rail will cut into the concrete faster than into a wood tie.

I would use a 131-lb. rail for my circle rail to give it maximum stiffness. I would imbed a cast-steel shoe into the concrete and anchor it securely. On top of this I would place a pressed-wood cushion to support the tie plates upon which the rail rests directly. The tie plates can be held in place by means of independent anchor bolts of the type that can be renewed when desired, and the rail can be fastened by clips attached by means of the anchor bolts. At the incoming and outgoing leads where the rail receives its worst abuse, these cast-steel shoes should be increased in plan to give a greater bearing area, and it is sometimes desirable to provide a special design of tie plate for this point, to insure greater thickness of metal.

Constructing Pipe Trenches

What minimum width should be required for pipeline trenches? Why? What is the most economical width? What difference does the diameter of the pipe or the depth of the trench make?

Solve for Each Case

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Determination of the minimum width for pipe trenches is so completely an individual problem for each trench, and sometimes for different sections of the same trench, that it can be made only in the light of conditions on the ground. However, a general statement is possible for relatively shallow trenches, for pipe not more than 10 in. in diameter, which is to be coupled, by either welding or the use of sleeve joints. If the trench is not to be more than four feet deep, all that will be necessary will be sufficient width, say 14 in., to allow the men to handle the dirt easily. In such trenches the only points that will need to be wider will be where other connections are to be made, to give room for the workmen, and where fittings may be introduced.

Where cast-iron pipe with bell and spigot joints is to be laid, the general width of the trench should be not less than 6 in. greater than the diameter of the pipe to allow a dependable job of tamping the back fill around the pipe to be done. At the joints it will be necessary to excavate to a width of 8 in. beneath and on each side of the bell, to permit the pouring of the jointing material and allow room for using the calking tools with which the joint is made secure against leakage.

If vitrified clay pipe is to be laid for subsurface drainage, without sealed joints, only sufficient room to permit tamping the back fill will be needed, say about 2 in. more than the diameter of the bell. If the line carries sewage and the joints must be sealed, this width should be 4 to 6 in., depending on the diameter of the pipe, to allow the cement to be placed dependably in the joint. Because vitrified pipe comes in short lengths, the entire trench will need to be of uniform diameter.

One of the important things to be kept in mind when planning and executing a trench job is that excavation of this type is expensive and that every inch of width more than necessary represents waste with respect to cost as well as to effort. For this reason, under normal conditions the width of a pipe trench should not vary much beyond the limits of careful workmanship. It should also be borne in mind that any pipe line, whether working under pressure or gravity, will give a better performance if it is straight. For this reason, pipe trenches should be laid out carefully and held to alinement. Normally there should be no difficulty in doing this, and little excuse for not doing so.

In clay soils that are subject to caving it will be necessary to install bracing, and in other unstable ground sheeting may be necessary. The extent of these installations will depend on the depth of the trench and the degree of instability. In practically all cases where protection becomes necessary, the width of the trench will need to be increased at least by the thickness of the sheeting and bracing. If the trench is of considerable depth, it will usually be desirable to widen it at the top and decrease the width progressively at intervals as the depth increases.

Where trenching machines are employed, the unit cost of the excavation is so greatly decreased, compared with hand digging, that it may be much more economical to allow the greater width necessary to accommodate the trenching buckets. Where such machines are used, however, it is always wise to pay special attention to tamping the backfill up to and somewhat above the top of the pipe to insure that it will be well supported and protected against lateral movement.

Must Be Room to Work

By J. P. Hanley
Inspector of Water Service, Illinois Central, Chicago

Generally speaking, the most economical width for a pipe trench is that width that is just sufficient to permit the outside diameter of the pipe or pipe joint to enter it without undue interference. This general statement must be modified, however, because the most economical width may be influenced considerably by the method followed in the construction of the trench, by its depth and by the space needed for sheeting or bracing if this becomes necessary.

If the trench is constructed by hand, that is, by pick and shovel, the minimum width must be sufficient to allow the trench diggers enough room to work economically. This is usually two spades wide, or about 16 in. This width is also sufficient for pipes up to 10 in. in diameter, provided the trench is of moderate depth. In addition to this general width, the recesses or bell holes should provide a clearance of 6 in. beneath and on both sides of the bell at every joint, and of 18 to 20 in. ahead of it to permit application of the jointing material. Unless it is unavoidable, the trench should not depart from a straight line, because a crooked trench causes cramping of the pipe joints or calls for increased width where a straight line is specified.

Where a trenching machine is employed in the construction of a trench, the minimum width will usually correspond to the width of the trenching bucket, although in some of the later designs of trenching machines, the width of the bucket can be adjusted to suit conditions. In machine trenching a considerable increase in the width of the trench is sometimes more economical than sheeting or bracing, where caving is feared.

If the trench is of unusual depth, or is cut in soft or otherwise unstable ground, it may be excavated unusually wide at the top and stepped at suitable depth intervals to form terraces on each side, thus decreasing the width at these intervals until normal or nearly normal width is reached at full depth. This scheme will sometimes make a saving in sheeting costs greater than the cost of the extra excava-

tion, and at the same time permits more economical handling of the unstable material.

Where the pipe line is laid under streets, tracks or elsewhere where an open trench is undesirable, the tunneling method should be considered for the larger sizes of pipes and a pipe pusher or jack for those of smaller diameter, since these methods will not disturb the surface of the ground or street. The tunneling method may also be much more economical where a trench would need to be of excessive depth. Where tunneling is performed in connection with the installation of the larger pipes, the annular space between the pipe and the tunnel should be kept filled with sand or other fine material that can be tamped solidly, to prevent surface settlement.

It should be kept in mind that every trenching job has peculiarities of its own, for which reason it should be studied separately but carefully. Obviously, the removal of minimum yardage should be the first consideration; yet yardage should be increased freely if conditions indicate that such increase is economical.

Is Cutting or Burning Best?

Can weeds on the right of way be controlled better by burning than by regulated mowing? Why? Is burning more destructive to objectionable weeds than to desirable grasses?

Burning Is Incidental

By District Engineer

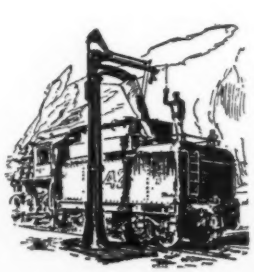
Weed destruction in the area outside of the roadbed section has two primary objectives: (1) to improve the appearance of the right of way and (2) to avoid the probability of destructive fires that may get out of control. Such secondary objectives as control of erosion, elimination of pernicious weeds and improvement of the view at grade crossings may be as important, or even more so, in some localities than the primary objectives.

Most of the weeds with which the maintenance forces have to contend are annuals or biennials, so that, in general, if that portion of the plant that appears above the ground is destroyed at any stage of its growth, it will not reappear, as the grasses, which are perennials, will invariably do unless the crown and root system are destroyed also. However, Bermuda grass and Johnson grass, the two most difficult to handle of all of the types of vegetation that grow on the right of way, being grasses and perennials, are not destroyed by either cutting or burning. These particular grasses provide a special problem which cannot be solved in the same way as that of the general run of weeds and will not be discussed further.

Considering the kinds of weeds that grow most widely and the dates on which they mature, we find that the period of maturing extends from early summer until well into the fall. A few plants that seed early produce a second crop that seeds during the same season. In some cases, the seeds from the second crop lie dormant until the following spring; in others they germinate during the late summer and fall, producing plants that spring up vigorously during the first warm days of spring. Still another type, generally annuals, but real pests, represented by the plant known variously as Job's gourd, velvet weed, etc., produces seed that may lie dormant for many years, only to germinate when conditions are favorable.

Annuals and biennials among the weeds persist because, through a long course of development during which they have by force of circumstances been compelled to exist under adverse conditions, they have become hardy and prolific. Since this class can persist only through seeding, during their evolution some of them have come to produce seeds that will germinate before they have reached complete maturity.

It follows that a single cutting of the right of way during the growing season will destroy only a part of the weeds. If it is desired to eliminate the early-maturing varieties, the early mowing that will be necessary will not touch those later plants that spring from seeds that germinate slowly. If the cutting is in the middle of the summer, many of the plants will have seeded already and the mowing will be useless so far as they are concerned. If the mowing is delayed until late in the summer, still more plants will have reached maturity and only a few varieties will be caught before they have seeded.



If the mowing can be done twice or, better, three times a season for several years, both the early and late varieties can be eliminated or at least brought well under control. A single mowing, however, simply suppresses certain varieties and encourages the growth of others. In most sections of the country, if the weeds can be kept down, desirable grasses will spread naturally and they, in turn, will tend to discourage the growth of weeds.

Burning is incidental to mowing. Vegetation cannot be burned when green, so that if it is to be burned it must first be cut and allowed to dry, or it must be allowed to reach maturity and then be burned after the plants are dead and dried out. In the latter case, some seeds will undoubtedly be destroyed, but only a part of them, while a growth of weeds rank and dense enough to be burned in this manner will leave the right of way with a rather unpleasing appearance.

Keep Weeds Cut

By Roadmaster

Desirable grasses do not grow well where weeds grow thickly, for if not controlled, most types of weeds form a dense rank growth that chokes out the grass plants. Consequently, in many cases, the grasses are not affected by the burning of the weeds. Furthermore, the burning of the grass itself, after it is dead in the fall and is well dried, will not damage the growth, for it will grow vigorously next spring. If, however, weeds have gotten out of control and are growing thickly in areas where desirable grasses have a good foothold, and to bring them under control, they are cut and allowed to dry out and are then burned over the growing grass, the heat from the fire is likely to damage the crown and kill the grass.

If the right of way has a good stand of grass and few weeds, I could cut the weeds by hand (scythe) well before they have matured their seeds, and allow the grass to seed before it is mowed. In this way the further spread of the weeds will be retarded, while the grass seed that will be shelled out will insure a continuation of the stand.

Obviously, there will be no oppor-

tunity to burn the right of way without mowing it, unless it is allowed to go without cutting until the plants have been killed by frost. At this time it will be too late for burning to be of any benefit with respect to control of the weeds, for most of the seed will have already been discharged from the seed pods to fall on the ground or to float away to some other point.

Foremen for Work Trains

Should foremen for work-train service be specially selected? Why? What qualifications are required?

Must Be Experienced

By L. D. Gardner
Roadmaster, St. Louis-San Francisco, Ada, Okla.

A foreman assigned to work-train service should, first of all, be a good trackman, so that he will understand how material is used. This knowledge will often save the cost of another handling after the material has been unloaded. He should be experienced in the loading and unloading of materials, especially if he is to handle heavy units, to prevent personal injuries. Such a foreman should have sufficient knowledge of transportation and operating matters, and sufficient experience to understand train orders and thus be able to obtain the best results under the train orders that are put out to cover the work of the train. This knowledge and experience will save unnecessary delay to both the work train and revenue trains. It follows, therefore, since only a relatively few foremen possess all of these qualifications, that foremen to be assigned to work-train service should be selected specially.

Must Have Personality

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

I consider it to be of the highest importance that only a foreman with the proper qualifications be assigned to work-train service, and since only a relatively few men possess these qualifications it follows that they should be selected specially for this service. First of all, he must be interested in his work and alert both mentally and physically to take advantage of every opportunity to avoid delays to the train and loss of time to the men accompanying it.

Second, he should be experienced in the class of work to be done by the train. If he is to handle heavy material, he should know how to load and unload it without hazard of personal injury to the men engaged in the work; and without damage to the material, such as treated and untreated bridge timbers, structural steel, rails, etc. He should also be dependable with respect to non-interference with trains on adjacent tracks.

Not every foreman is adept at handling material or can be depended on to do a first class job when working with other branches of the service. Driving piles with a track driver is a good example of work that demands complete cooperation between the foreman and the train crew. It has been proved many times that some foremen will turn out from 10 to 20 per cent more work with a work train than other foremen, who are apparently as good workmen, will do. This includes many foremen who do good work and handle their gangs satisfactorily. This indicates that one of the important qualifications for a work train foreman is that he have a personality that will lead train crews to respect and work with him.

Hazards with Track Jacks

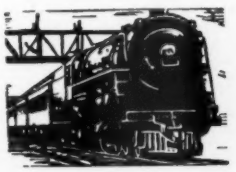
What practices should be prohibited to insure against injury to men using track jacks?

Accidents Can Be Serious

By M. J. Hanna
General Foreman, Track and Labor Department, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

When a jack is to be removed, it should be lowered notch by notch until it is relieved of the weight it has been carrying. Tripping the jack or dropping the load, while a general practice, is unsafe, and trackmen should not be allowed to form the habit of doing this. While there is some hazard to the man manipulating the jack, the real danger is to other men in the gang, who may be adjusting tie plates, doing something that brings a foot near the rail, or other tasks which may require contact with the rail. I have seen spikes and particles of dirt fly and strike a workman with enough force to cause an injury as a result of the unannounced tripping of a jack. Furthermore, tripping causes undue wear on the dogs, so that the jack may not catch as it should in making a lift.

The lever should be removed from the socket immediately after the raise is completed, for if anything goes wrong the bar may be thrown with great force and cause fatalities or serious injuries. Carelessness causes most accidents, and carelessness starts with the men in the gang. It can be eliminated quickly by the foreman if he cares to do so. If the men get into careless habits it is almost axiomatic that the foreman has been indifferent and allowed the habit to grow to the point where the careless movement becomes almost automatic.



Gives Series of Don'ts

By G. S. Crites
Division Engineer, Baltimore & Ohio, Punxsutawney, Pa.

1. Don't allow incompetent men to handle track jacks.
2. Don't use defective jacks or jack handles; or unsuitable jacks or jack handles.
3. Don't overstrain jacks.
4. Don't set jack on yielding bottom.
5. Don't set jacks so they lean.
6. Don't set the lifting lug only partly under rail.
7. Don't leave the jack handle in the socket after the lift is made.
8. Don't set the jack in tripping position until ready to trip.
9. Don't trip the jack without knowing that all hands and feet are in the clear.
10. Don't leave jacks standing up when not in use.
11. Don't put a hand under the rail to clean the top of the tie or the

tie plate while the rail is being held on the jack.

12. Don't use jacks without flag protection where such protection is needed.

Make Sure of Your Man

By W. Woolsey
Section Foreman, Illinois Central, Chicago

Never allow an inexperienced man to operate a track jack. Make sure that the man you select understands how to handle it, and that he can tell whether it is in good working order; if it is not, it should not be used. After the jack has been placed, the man operating it should remain with it until it is released; do not put him to doing something else. Do not allow the parts to become gummed and dirty; this is especially important with respect to the hinges and stem notches, for it will hinder the functioning of the working parts, and may result in personal injuries. These parts should be washed out with kerosene occasionally.

Men are sometimes injured through the use of an improper kind of bar for the jack lever. A lining bar is too long and if it is to be used it should be cut off, and the square end should be ground to fit the socket without sticking when it is to be removed. The lever should never be left in the jack after the raise is completed; if the dogs or latches are not fully caught in the notches they may slip, with disastrous results if the lever is still in the socket. Never stand the jack up when not in use. When hauling it on the motor car, place it on the rear end. Do not place the jack between ties that are so close together that the base of the jack must be squeezed between them, because it may be difficult to release it in case of emergency. Under no circumstances should a jack ever be placed on the inside of the track. In the remote possibility that this cannot be avoided, it should be done only under full flag protection.

Roofs for Transfer Platforms

What type of roofing is most satisfactory for freight transfer platforms? Why?

Uses Umbrella Roof

By L. G. Byrd
Supervisor Bridges and Building, Missouri Pacific, Poplar Bluff, Mo.

Practically all roads construct the roof for elevated freight-transfer platforms as flat as possible, using generally the umbrella or butterfly design, or a hip roof. Such structures require that the roofing material be laid continuously from eaves to eaves or from hip to eaves. To insure against injury to the roofing it is essential that the sheathing be laid tight and that it be fastened securely to guard against the effects of wind pressures which sometimes are of considerable magnitude. For the flatter roofs it is our practice to use built-up roofing. If the roof is of the hip design with a pitch of 4½ in. or more to the foot, we have found that asbestos shingles are quite satisfactory and have the advantage of requiring very little attention, provided they have been laid in a workman-like manner.

It should not be overlooked, however, that a built-up roof is the most economical roof that can be constructed on these sheds where conditions (that is, where the pitch is flat enough) warrant its use. If properly applied, with close attention to the flashing, a roof of this type will last for many years and will require practically no maintenance for the first half of its service life. It should be watched carefully and inspected at regular intervals, however, for, in common with other types, it may suffer external damage at times and in ways that cannot be foreseen.

Should Be Permanent

By Supervisor of Bridges and Buildings

It is assumed that the question refers to freight-transfer platforms that are intended to remain on the site of their construction to the end of their service life; in other words that they are permanent structures. If the construction is only temporary, any cheap roofing material that will conform to the design and insure protection during the limited life of the facility will be satisfactory.

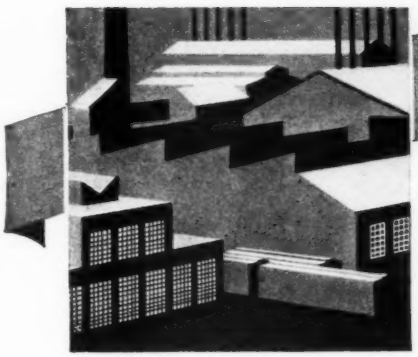
I am aware that my ideas are not altogether in conformity with current thought on the subject of building construction, which has been influenced so largely during the decade that is now closing, by inability to obtain appropriations for building maintenance and, in some instances, by insufficient funds to do a first-class job where new buildings are required. When installing a roof on a permanent building of any type, I would use only the best materials, for it is not debatable that, in the long run, the best roof is the cheapest.

This statement is intended to apply primarily to the cost of maintenance. Every building man knows that cheap roofing is most expensive to maintain, and that high-grade materials reduce maintenance to the minimum. Furthermore, a roof constructed of dependable materials affords assurance that it will protect the structure and its contents from the elements as it is intended to do, while by reason of the lack of this protection, a cheap or a poorly constructed roof may create far more damage than the difference in the cost of the two materials and their application.

For reasons that are not necessary to recite, the roofs of freight-transfer platforms are usually of the butterfly type; that is, they are relatively flat and reverse the usual procedure by sloping from the eaves toward the center. This brings the drainage to the middle of the platform, where it is usually disposed of by means of down spouts alongside the roof columns. This form of roof construction immediately eliminates many roofing materials and thus restricts the range from which selections can be made. The flashing problem thus created also adds some restrictions to this selection.

In my own case, I have never used any roofing other than the built-up tar and gravel type for freight-transfer platform roofs, although I have built several such structures. In one instance we had a transfer platform built several years before I came to the division upon which it was located. The roofing was of the "ready roofing" type, with the joints sealed with a good grade of mopping pitch. It was difficult to maintain, however, and frequently gave trouble from leakage. Eventually, this roof was replaced with one of the built-up type and our roofing troubles practically ceased.

This subject should not be dismissed without a word about flashing. Obviously, the design in which the eaves are higher than the middle of the roof introduces a problem somewhat different from that where the eaves form the low point of the roof, while the flashing of the downspouts, which are virtually at the bottom of a trough is of special importance. The details must be worked out for individual cases, but it should not be overlooked that the adequacy or inadequacy of these details may be the difference between success or failure for the roof.



PRODUCTS of Manufacturers

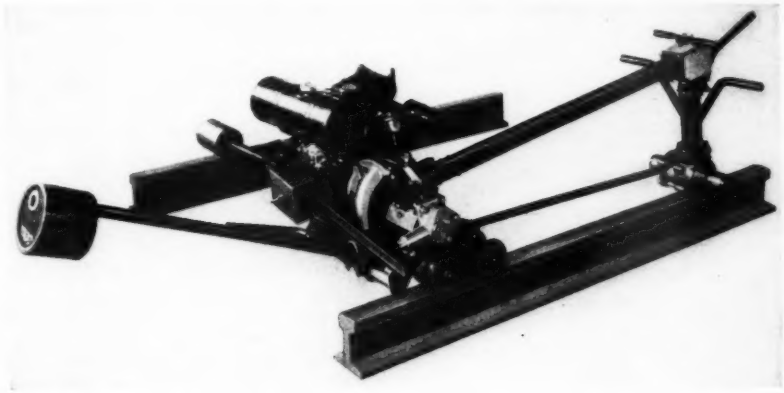
New Power Release for Raco Nut Runner

THE Railroad Accessories Corporation, New York, has equipped its power nut runner, known as the Raco power track machine, with a new type load release for controlling the torque applied to track bolt nuts. The new release, which is known as the Micro cut-out and dynamometer, is said to assure a much higher degree of accuracy in controlling torque than was possible with the type of release that it replaces. In fact it is reported that in a series of tests conducted with the new cut-out the maximum error was only three per cent.

Originally a slip clutch was provided in the Raco nut runner for controlling the torque applied to track bolts. The new release, however, is said to be entirely mechanical in its operation, no friction or spring members being used. Employing the same principle as the platform scale, it embodies a dynamometer arm carrying a movable weight which is comparable to the weight on the beam of a scale. The amount of torque applied to nuts, measured in inch-pounds, can be varied as desired by shifting the weight on the arm, there being 20 different settings on the dynamometer arm for this purpose.

When torque is applied to a bolt with the machine, the load is transferred through the Micro mechanism to the dynamometer arm. When the load becomes sufficient to counterbalance the weight, the arm assumes a tilting or floating position in the same manner as the weigh beam of a platform scale when an object is being weighed. The movement of the arm is transmitted through a worm gear to a friction clutch in such a manner that, when the torque becomes large enough to cause the arm to tilt, the clutch plates are forced apart, releasing the drive connection to the chuck.

The Micro cut-out is not only being applied to new Raco power track machines but it is also available for application to machines in service.



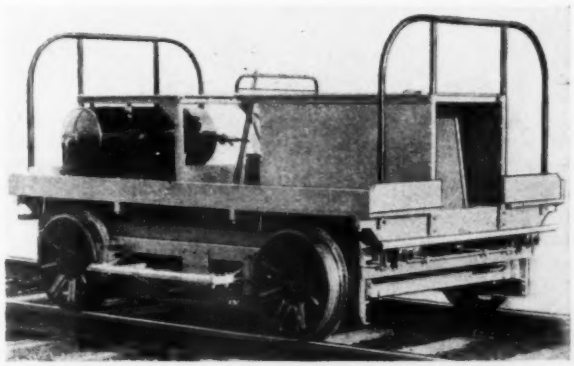
The Improved Raco Power Track Machine. The Dynamometer Arm for the New Load Release Can Be Seen Near the Inner End of the Arm Carrying the Counterweight

Fordair Rail Car in Larger Model

SCHRAMM, Inc., West Chester, Pa., has introduced a new and larger version of its Fordair self-propelled rail car and compressor, which replaces the previous model. In outward appearance the Fordair rail car resembles a standard motor car and provides a means of transporting men and tools as well as supplying compressed air.

The new unit consists of a Fordair Model 60 air compressor and motor installed in place of the V-8 engine in a Model A-6 Series C Fairmont motor car. It delivers 60 cu. ft. of air per minute at a pressure of 100 lb. per sq. in., which compares with a capacity of 55 ft. per min. for the earlier model. It is said that the increase in the output of the compressor has been achieved without increasing the size and weight of the entire unit.

The new machine will operate four tie tampers, a small rock drill, rotary drills, breakers, paint spray guns, or other air tools. It has a road speed of 20 miles per hour, and has a lifting weight, with the rear extension han-



The New Model 60 Schramm Fordair Self-Propelled Rail Car and Compressor

Continued on page 690

dles withdrawn, of 650 lb. The air tank, which is 14 in. in diameter and 26 in. long, is mounted under the seat where it does not detract from the available load-carrying space.

It is pointed out that the engine-compressor unit that is used in the Fordair rail car can be installed to replace the engine in any motor car that is operated by a Ford V-8 engine.

New Buda Tie Puller

THE Buda Company, Harvey, Ill., has developed a tie puller weighing 54 lb., which, it is said, can be easily carried and operated by one man and can be quickly and easily removed from the track. It consists of a rectangular steel cross bar, which fits over the ball of the rails. At one end of the cross bar, which projects out to the end of the ties, a lever arm is fastened, which contains a socket for applying a standard lining bar. The lower end of the lever arm is connected to a pair of jaws, which grip the sides of the tie.

In its operation, after the spikes are pulled and the tie plates removed, the tie puller is placed across the rails over the tie to be removed, the jaws are placed on each side of the tie near the outside edge of the rail, a lining bar is placed in the lever arm socket, and one man standing on the tie in the center of the track, pulls on the lining bar. Successive pulls on the lining bar, with a jacking motion, cause the jaws to take fresh grips on the tie without being reset by hand, and the operation is continued until the tie has been pulled out from under both rails.

Illustrating the Operation of the Buda Tie Puller

The tie puller is made in sections, fully insulated, so as not to short signal circuits. It is said to remove ties without throwing the track out of line and to increase the efficiency of section gangs in tie renewal work by as much as 25 per cent.

Jackson Solo Tamper

THE Electric Tamper & Equipment Company, Ludington, Mich., has developed the Jackson Solo Tamper, which consists of a small, light-weight portable power plant and a standard Jackson streamlined tie tamper and which is adapted particularly for use by small gangs for spot tamping, tamping up loose ties and low joints and other small tamping jobs. The power unit consists of a direct-connected gasoline engine and generator, provided with rollers and an outrigger for rolling short distances along the track by hand or for pulling along on the rails by means of the 14-ft. cable connected to the tamper. The power unit weighs 100 lb. and occupies a ground space of 20 in. by 8½ in. It generates 750 watts of 110-volt, 3-phase, 60-cycle current.

The Power Unit Equipped with an Outrigger for Movement on the Rails

For work around switches, crossings, frogs and general yard work, it may be connected to the tamper by a flexible cable 40-ft. long to provide an ample operating radius without moving the power unit. When used with an outrigger, the tamper can be placed in a socket provided on the outrigger for that purpose, which allows the entire unit to be moved on the track, without the necessity for the operator carrying the tamper. A telescopic shoe or guide is also provided for use with the outrigger to prevent a derailment. One man can easily remove it from the track.

The Jackson streamlined tie tamper, which completes the Solo Tamper outfit, was described in the March issue, page 192.

New Books

Who's Who in Railroading

WHO'S WHO in Railroading in North America. 716 pages. 8¾ in. by 5¾ in. Bound in cloth. Published by the Simmons-Boardman Publishing Corporation, New York. Price $7.50.

This is the tenth edition of this standard biographical reference volume of leaders in the railway and allied fields. It is especially welcome at this time, coming as it does after an interval of ten years, during which such marked changes in personnel have occurred. The first edition appeared in 1885 as the Biographical Directory of Railway Officials of America, and retained this designation to and including the eighth edition which appeared in 1922. The ninth edition was issued in 1930 under the present title and broke away to some extent from the rigid inclusion of railway officers only.

In the 1940 edition the coverage has been broadened still further, to include, in addition to railway officers, leaders in the railway equipment and supply manufacturers' group, railway labor leaders, members of state and federal regulatory bodies, transportation economists, specialists in railway finance, educators concerned with railway problems, I.C.C. practitioners, consultants, authors, editors and other experts. The biographical data include not only the facts concerning the business careers of those who are mentioned, but data concerning family, social, political and religious affiliations as well.

NEWS of the Month

A. A. R. Studying Plan For Air-Rail Freight Agency

The Association of American Railroads has received and is studying a plan calling for a nation-wide air-freight company to be owned jointly by the country's air lines and railroads. According to what has been learned of the plan, it contemplates that the initial function of the new company would be to conduct comprehensive investigations and cost studies of air-freight operations, based upon the development of new types of cargo planes for such transportation.

Grade-Crossing Bill

A compromise conference report on the federal-aid highway authorizations bill for the fiscal years ending June 30, 1942,, and June 30, 1943, has been adopted by the Senate and House and has been signed by the President. As passed by the House the grade-crossing authorizations were fixed at $37,500,000 for each year, and the Senate bill authorized $20,-000,000 for each year. The compromise conference report which was passed adopted the Senate figures.

G. M. & N. and M. & O. Merger Completed

On September 13, the merger of the Gulf, Mobile & Northern and the Mobile & Ohio to form a new 2,000-mile trunk-line system, the Gulf, Mobile & Ohio, was consummated. The new system provides two routes from St. Louis, Mo., to Mobile, Ala., and one from St. Louis to New Orleans, La., with trackage rights to Memphis, Tenn., and Birmingham, Ala. I. B. Tigrett, formerly president of the Gulf, Mobile & Northern, will head the Gulf, Mobile & Ohio.

Rail Employment Up 5.4 Per Cent

Railroad employment increased 0.87 per cent, or from 1,050,254 to 1,059,364, during the period from mid-July to mid-August, while the August total was 5.4 per cent above that for August, 1939, according to Interstate Commerce Commission figures, based on preliminary reports. August employment in all groups was above that of July as well as being ahead of August, 1939. The largest increase over August, 1939, was in the maintenance of equipment and stores group, up 9.73 per cent, while the train and engine service group was up 5.68 per cent and the maintenance of way and structures group increased by 4.91 per cent.

Pere Marquette Launches World's Largest Carferry

On September 18, the Pere Marquette launched the City of Midland, largest, most modern and one of the fastest carferries in the world. The ship, which cost $2,000,000, was built by the Manitowoc Shipbuilding Company at Manitowoc, Wis., and will be placed in service in 1941 between Manitowoc and Ludington, Mich., transporting passengers, freight cars and highway vehicles across Lake Michigan. It will have a carrying capacity of 34 loaded freight cars, 50 automobiles and 376 passengers.

Jobless Railroaders Available For Defense Industries

More than 33,000 unemployed railroad workers are available for defense industries, and more than 25,000 of them are willing to bid for such a job anywhere in the country, according to information received up to the end of July by the Railroad Retirement Board in 73,000 returns from a questionnaire which the Board sent out at the end of June to approximately 210,000 railroaders who had registered for benefits under the Railroad Unemployment Insurance Act during the fiscal year 1939-40. The information received is being forwarded by the Board to the National Defense Advisory Commission.

Maintenance Union President Retires

On September 1, Frederick H. Fljozdal, president of the Brotherhood of Maintenance of Way Employees for the past 18 years, voluntarily retired. He was succeeded by Elmer E. Milliman, formerly secretary-treasurer of the union.

Mr. Fljozdal was born in Iceland in 1868 and entered railroad service in 1886 in the construction department of the Great Northern. In 1898, after eight years employment with street railways, he went with the Canadian Northern (now Canadian National) as a construction foreman. In 1900, he became a general foreman for the same road and in 1920 was made a track supervisor. His first officership with the maintenance of way brotherhood came in 1905 when he was elected general chairman for the Canadian Northern. In 1914 he became secretary of the executive board of the entire brotherhood and in 1916 chairman of the board. The year 1918 saw his election as vice-president and in 1922 he became president, which position he held until his retirement on September 1.

President Signs Transportation Bill

On September 18, President Roosevelt signed the Wheeler-Lea omnibus transportation bill, thereby making it the Transportation Act of 1940. The bill which was described briefly in the September issue, page 584, was passed by the Senate on September 9. It is the most important piece of transportation legislation enacted since the passage of the Transportation Act of 1920. The new Act amends various provisions of the present Interstate Commerce Act, Part I and Part II, and the Motor Carrier Act, while adding a new Part III for the regulation of water carriers.

11,986 Air-Conditioned Cars

On July 1, Class I railroads and the Pullman Company had 11,986 air-conditioned passenger cars in operation, according to the Association of American Railroads. This was an increase of 635 compared with the number of air-conditioned passenger cars on July 1, 1939, and an increase of 271 since January 1 of this year. Of the total number of such cars, Class I roads had 6,852 on July 1, an increase of 525 compared with the same date last year and the Pullman Company had 5,134, or an increase of 110 compared with July 1, 1939.

Big Four Foremen Hold Annual Meeting

The Association of Maintenance of Way Foremen of the Cleveland, Cincinnati, Chicago & St. Louis (the Big Four) held its 18th annual convention at Indianapolis on August 30-31. At this convention, reports were presented on The Use of Individual Tie Tampers, What the Foreman Can do to Maintain and Use New Labor Saving Machines, Time Tables, What the Foreman Should Know, and String Lining Curves. At the banquet, Elmer T. Howson, editor of *Railway Engineering and Maintenance*, spoke on The Railways and National Defense.

Personal Mention

General

D. L. Keiser has been elected vice-president-maintenance of the Texas Mexican, a newly created position, with headquarters at Laredo, Tex.

J. P. Allison, supervisor of track on the Erie at Jersey City, N. J., has been promoted to inspector of operation, with headquarters at Cleveland, Ohio.

Corbett W. Coil, trainmaster on the Northern Pacific at Minneapolis, Minn., and for many years a roadmaster and division roadmaster at various points on that road, has been promoted to assistant superintendent at Duluth, Minn.

D. A. Thomson, trainmaster-roadmaster of the Minnesota & International (a subsidiary of the Northern Pacific), with headquarters at Bemidji, Minn., has been appointed trainmaster on the Northern Pacific at Fargo, N. D., and **R. W. Davis,** division roadmaster on the Northern Pacific, with headquarters at Minneapolis, Minn., has been promoted to trainmaster-roadmaster of the M. & I., at Bemidji, succeeding Mr. Thomson.

J. C. Wallace, assistant chief engineer of the New York, Chicago & St. Louis (Nickel Plate), with headquarters at Cleveland, Ohio, has been promoted to assistant general superintendent, a newly created position, with the same headquarters. Mr. Wallace was born at Harrisburg, Pa., on November 1, 1886, and graduated in civil engineering from Pennsylvania State College in 1911. He entered railway service in April, 1914, as a structural draftsman on the Chicago, Milwaukee, St. Paul & Pacific and four years later he went with the Lake Erie & Western (now part of the Nickel Plate), as engineer of structures, later becoming district engineer at Indianapolis, Ind. In May, 1925, Mr. Wallace was promoted to assistant chief engineer of the Nickel Plate, with headquarters at Cleveland, the position he held until his recent promotion, which was effective September 1.

John L. Downs, superintendent of the Illinois division of the Illinois Central, with headquarters at Champaign, Ill., and a maintenance of way officer by training and experience, retired on September 1. Mr. Downs was born at Greencastle, Ind., on August 20, 1870, and entered the service of the Illinois Central on August 1, 1896, as a section foreman at Kankakee, Ill. On March 1, 1897, he was promoted to track supervisor at Pana, Ill., and later served in that capacity at Kankakee and Rantoul, Ill. On April 1, 1902, he was promoted to roadmaster at Fort Dodge, Iowa, and two years later he was transferred to Vicksburg, Miss. On September 1, 1911, he was transferred to Memphis, Tenn., and eight years later he was transferred to Champaign. Mr. Downs was advanced to district engineer of the Northern lines, with headquarters at Chicago, on February 1, 1925, and on October 1, 1929, he was promoted to superintendent of the Illinois division, with headquarters at Champaign, the position he held until his retirement.

Engineering

C. A. Maxeiner, supervisor of track of Subdivision 9 of the Syracuse division of the New York Central, with headquarters at Syracuse, N. Y., has been promoted to division engineer of the St. Lawrence, Adirondack and Ottawa divisions, with headquarters at Watertown, N. Y., effective September 1, succeeding **P. L. Barker,** who has retired.

Charles R. Wright, district engineer of the Lake Erie & Western district of the New York, Chicago & St. Louis (Nickel Plate), with headquarters at Frankfort, Ind., has been promoted to assistant chief engineer, with headquarters at Cleveland, Ohio, succeeding **J. C. Wallace,** whose promotion to assistant general superintendent, with headquarters at Cleveland, is announced elsewhere in these columns. Mr. Wright was born at Ravenna, Ohio, on June 10, 1885, and attended college for two years. He entered railway service on April 16, 1906, as a draftsman in the general office of the Nickel Plate at Cleveland. In 1910, he was promoted to chief draftsman and in September, 1919, he was appointed division engineer at Conneaut, Ohio. Mr. Wright was transferred to Cleveland in July, 1920, and in June, 1925, he was advanced to district engineer of the Lake Erie & Western district, with headquarters at Indianapolis, Ind. In January, 1931, he was transferred to Frankfort, Ind., where he was located until his recent promotion.

Charles R. Wright

E. R. Shultz, supervisor of track on the Pennsylvania at Lancaster, Pa., has been promoted to division engineer of the Columbus division, with headquarters at Columbus, Ohio, succeeding **A. J. Greenough,** who has been transferred to the Pittsburgh division, with headquarters at Pittsburgh, Pa., replacing **C. F. Trowbridge.** Mr. Trowbridge has been appointed division engineer on special duty in the office of the chief of freight transportation at Philadelphia, Pa. **F. M. Hawthorne,** division engineer at Cleveland, Ohio, has been appointed division engineer on special duty in the office of the chief engineer maintenance of way of the Eastern region, with headquarters at Philadelphia, and **Edward E. Kinzel,** supervisor of track at Washington, D. C., has been promoted to division engineer, with headquarters at Cleveland, relieving Mr. Hawthorne.

M. S. Smith, Jr., supervisor of track on the New York zone, with headquarters at New York, has been promoted to division engineer of the Monongahela division, with headquarters at Pittsburgh, Pa., to succeed **A. H. Stimson,** who has been transferred, as division engineer, to special duty in the office of the chief engineer at Philadelphia.

C. B. Porter, resident engineer on the Chesapeake & Ohio, with headquarters at Huntington, W. Va., has been promoted to assistant division engineer of the Huntington division with the same headquarters, to succeed **R. R. Burchett,** whose promotion to division engineer of the Chicago division, with headquarters at Peru, Ind., was announced in the August issue.

In connection with the merger of the Gulf, Mobile & Northern and the Mobile & Ohio, to form the Gulf, Mobile & Ohio, **L. P. O. Exley,** chief engineer of the G. M. & N., has been appointed chief engineer of the new system, with headquarters as before at Mobile, Ala., and **H. Austill,** chief engineer of the Mobile & Ohio, with headquarters at St. Louis, Mo., has been appointed chief engineer maintenance of way and structures of the G. M. & O., with headquarters at Mobile.

Chester T. Dike, vice-president (engineering) of the Chicago & North Western, and vice-president and chief engineer of the Chicago, St. Paul, Minneapolis & Omaha (a subsidiary of the Chicago & North Western), with headquarters at Chicago, retired on August 31. **Ralph R. Strother,** assistant chief engineer and superintendent of way and structures of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn., has been promoted to chief engineer, with the same headquarters, succeeding to the duties of Mr. Dike, on the Omaha. A biographical sketch of the career of Mr. Dike, accompanied by a photograph, was published in the May issue, page 337, following the relinquishment of his duties as chief engineer of the North Western on April 1.

Ralph R. Strother

Mr. Strother was born at Hubbard, Iowa, on August 17, 1885, and graduated in civil engineering from Iowa State Col-

lege in 1907. He entered railway service as a chainman in the engineering department of the North Western in September, 1909, and later was appointed rodman and instrumentman on location. On June 15, 1914, he was promoted to assistant engineer on field work for the Omaha. In 1920, he was advanced to assistant engineer in charge of estimates, with headquarters at St. Paul, and on February 1, 1929, he was promoted to assistant chief engineer. On November 1, 1938, Mr. Strother was also placed in charge of maintenance of way and structures.

John W. Porter, principal assistant engineer and right of way agent of the Western region of the Canadian National, with headquarters at Winnipeg, Man., has been promoted to chief engineer of the Western region, with the same headquarters, succeeding **E. M. M. Hill,** whose death on August 14, is announced elsewhere in these columns. A biographical sketch and photograph of Mr. Porter were published in the May issue, pages 337 and 338, following his promotion to principal assistant engineer and right of way agent of the Western region.

Track

D. B. Sisson, track supervisor on the Southern at Lawrenceburg, Ky., has been transferred to Huntingburg, Ind., succeeding **S. T. Montgomery,** who has been appointed assistant to the roadmaster at Somerset, Ky.

B. Pike has been appointed roadmaster on the Canadian National at Edmonton, Alta., succeeding **W. A. Chandler,** who has been transferred to North Battleford, Sask., replacing **Lars K. Sevick,** who has retired. **F. C. Dickson,** roadmaster at Fort Francis, Ont., has been transferred to Winnipeg, Man., relieving **E. C. Dunlop,** who has retired.

H. J. Hawkins, section foreman on the Illinois Central at Carbondale, Ill., has been promoted to track supervisor, with the same headquarters, succeeding **H. H. Fisher,** who has been assigned to other duties. The headquarters of **P. R. Henderson,** track supervisor at Litchfield, Ill., have been changed to Springfield, Ill.

H. S. Trenholm, general yard foreman on the Erie at Port Jervis, N.Y., has been promoted to supervisor of track on the Wyoming division, with headquarters at Dunmore, Pa., to succeed **R. W. Worthington,** who has been transferred to the Buffalo division, with headquarters at Warsaw, N.Y., to replace **A. H. Duane.** Mr. Duane has been transferred to Jersey City, N.J., to succeed **J. P. Allison,** whose appointment as inspector of operation is noted elsewhere in these columns.

J. M. Kirschner, assistant supervisor of track on the Pittsburgh division of the Pennsylvania, has been promoted to supervisor of track on the Williamsport division, with headquarters at Williamsport, Pa., succeeding **H. L. Byrne,** who has been transferred to the Baltimore division, with headquarters at Washington, D.C. Mr. Byrne replaces **Edward E. Kinzel,** whose promotion to division engineer, with headquarters at Cleveland, Ohio, is announced elsewhere in these columns.

H. J. Lattomus, whose promotion to supervisor of track on the Pennsylvania, with headquarters at Toledo, Ohio, was announced in the August issue, was born at Wilmington, Del., on February 3, 1911, and attended the University of Delaware from 1930 to 34. He entered railway service on June 26, 1934, as an assistant on the engineering corps at Newport, Pa., later serving in that capacity at Harrisburg, Pa., Tyrone, Philadelphia and York. In November, 1936, he was promoted to assistant supervisor at Enola, Pa., and in April, 1937, he was transferred to Dennison, Ohio, where he was located until his recent promotion.

Robert E. Blosser, whose promotion to supervisor of track on the Pennsylvania, with headquarters at Kalamazoo, Mich., was announced in the August issue, was born in Ohio on November 8, 1911, and graduated in civil engineering from Ohio State University in 1933. He entered railway service on May 10, 1934, as an assistant on the engineering corps of the Pennsylvania at Pittsburgh, Pa., later serving in that capacity at Niles, Ohio, and Erie, Pa. On January 16, 1936, he was promoted to assistant supervisor at Carnegie, Pa., and on July 16, 1939, he was transferred to Cresson, Pa., where he was located until his recent promotion which was effective July 19.

P. R. Gibson, roadmaster on the Northern Pacific at Minneapolis, Minn., has been promoted to division roadmaster, with the same headquarters, succeeding **R. W. Davis,** whose promotion to trainmaster-roadmaster of the Minnesota & International, with headquarters at Bemidji, Minn., is announced elsewhere in these columns. **T. A. Gregory,** roadmaster at Jamestown, N. D., has been transferred to Minneapolis, replacing Mr. Gibson, and **M. R. Smith,** roadmaster in charge of branch lines at Jamestown, has been appointed roadmaster in charge of the main line territory at Jamestown; relieving Mr. Gregory. **R. E. Schuett,** assistant bridge and building supervisor at Glendive, Mont., has been promoted to roadmaster at Jamestown succeeding Mr. Smith.

W. N. Myers, assistant supervisor of track on the Pennsylvania, has been promoted to supervisor of track on the E. & A. division, with headquarters at New Castle, Pa., succeeding **J. H. Kerchner,** who has been transferred to the Philadelphia division at Lancaster, Pa., relieving **E. R. Shultz,** whose promotion to division engineer, with headquarters at Columbus, Ohio, is announced elsewhere in these columns. **C. E. Gipe,** supervisor of track on the Conemaugh division, with headquarters at Aspinwall (Pittsburgh), Pa., has been transferred to the New York zone, with headquarters at New York, to succeed **M. S. Smith, Jr.,** whose promotion to division engineer is noted elsewhere in these columns. **Lisle E. McCarl,** assistant supervisor of track at New York, has been promoted to supervisor of track on the Conemaugh division at Aspinwall, to succeed Mr. Gipe.

C. Breth, assistant supervisor of track of Subdivision 2 of the Electric division of the New York Central, with headquarters at Harmon, N.Y., has been promoted to supervisor of track of Subdivision 32 of the Adirondack division, with headquarters at Malone, N.Y., succeeding **E. R. Murphy,** who has been transferred to Subdivision 9 of the Syracuse division, with headquarters at Syracuse, N.Y., succeeding **C. A. Maxeiner,** whose promotion to division engineer at Watertown, N.Y., is noted elsewhere in these columns. **H. J. Kingsland,** a track foreman has been promoted to assistant supervisor of track on Subdivision 29 of the Eastern division, with headquarters at Brewster, N.Y., succeeding **H. C. Fryer,** who has been transferred to Subdivision 2 of the Electric division, with headquarters at Harmon, to succeed Mr. Breth.

Joe Foster Herrin, assistant supervisor of bridges and buildings and water service on the International Great Northern (Missouri Pacific) at San Antonio, Tex., has been promoted to roadmaster, with headquarters at Palestine, Tex., succeeding **Benjamin C. Vanover,** who has retired. Mr. Herrin was born at Troup, Tex., on June 20, 1898, and entered railway service on September 10, 1920, as a motor car operator on the International-Great Northern at Palestine. Three months later he was appointed assistant scale supervisor and in July, 1922, he was appointed a rodman. He was transferred to Houston, Tex., as a draftsman in June, 1926, and returned to Palestine as a transitman in July, 1927. Mr. Herrin was promoted to assistant supervisor of bridges and buildings and water service at San Antonio in August, 1937, the position he held until his recent promotion.

R. C. Bishop, assistant supervisor of track on the Chesapeake & Ohio, with headquarters at Walbridge, Ohio, has been promoted to supervisor of track with the same headquarters, to succeed **F. A. Dirnberg,** retired. Mr. Bishop was born on October 26, 1904, at Bardwell, Ky., and was educated at the University of Kentucky, graduating in 1928 with a Bachelor of Science degree in civil engineering. He entered railway service with the C. & O. on June 18, 1928, as a carpenter helper on the Huntington division. In March, 1929, he became a rodman in the construction department and in November of the same year he was transferred in the same capacity to the maintenance of way department. In February, 1930, Mr. Bishop was appointed assistant cost engineer on the Ashland division, being transferred to the Huntington division in January, 1936. Three years later he was promoted to assistant supervisor of track on the Maumee district of the Hocking division, with headquarters at Walbridge, where he remained until his recent promotion to supervisor of track, which was effective on September 1.

Edgar N. Garrett, extra gang foreman on the Louisville & Nashville, has been promoted to track supervisor, with headquarters at Birmingham, Ala., succeeding **Henry L. Shields,** who has been transferred to Opp, Ala. Mr. Shields replaces **William A. Shaw,** who retired August 31.

Mr. Garrett was born at Warrior, Ala., on November 9, 1899, and entered railway service on September 1, 1918, as a laborer on the L. & N. He was made an appren-

tice foreman on May 1, 1919, and on February 10, 1920, he was promoted to section foreman, later serving in this capacity and as a yard foreman and an extra gang foreman until his recent promotion.

Mr. Shaw was born at Sturgis, Ky., on December 29, 1869, and entered railway service on August 15, 1885, as a track laborer on the L. & N., being promoted to section foreman a few years later. On August 31, 1897, Mr. Shaw was advanced to track supervisor, and served in this capacity until his retirement.

Bridge and Building

P. F. McNalley has been appointed assistant bridge and building supervisor on the Salt Lake division of the Southern Pacific, succeeding **T. W. Gosling,** whose promotion to water and fuel supervisor of the Salt Lake division was announced in the September issue.

N. R. Hill, assistant engineer on the Illinois Central at Waterloo, Iowa, has been promoted to supervisor of bridges and buildings, with the same headquarters, succeeding **H. Callahan,** whose death on July 26 is announced elsewhere in these columns.

H. W. Johnstone, track apprentice on the Northern Pacific, has been promoted to assistant bridge and building supervisor at Glendive, Mont., succeeding **R. E. Schuett,** whose promotion to roadmaster, with headquarters at Jamestown, N. D., is announced elsewhere in these columns.

Obituary

H. Callahan, supervisor of bridges and buildings on the Illinois Central, with headquarters at Waterloo, Iowa, was killed in an automobile accident near Galena, Ill., on July 26.

Arthur C. Watson, chief engineer of the Long Island and the New York zone of the Pennsylvania, with headquarters at New York, died on September 23 at the Roosevelt hospital in that city at the age of 59. Mr. Watson had been in ill health for some time.

E. M. M. Hill, chief engineer of the Western region of the Canadian National, with headquarters at Winnipeg, Man., died in that city on August 14. A biographical sketch and photograph of Mr. Hill were published in the March issue, page 204, following his promotion to chief engineer of the Western region.

George F. Blackie, who retired on January 1, 1940, as chief engineer of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn., died at that point on August 22. A photograph and biographical account of Mr. Blackie's career were published in the March issue, page 204, following his retirement.

James E. Rawlinson, who retired on May 31, 1938, as supervisor of bridges and buildings on the Louisville & Nashville, with headquarters at Louisville, Ky., died of a heart ailment at his home in that city on September 6. Mr. Rawlinson was born at Stigner, Ala., in 1868, and entered railway service on August 18, 1887, as a laborer in a bridge gang on the Birmingham division of the L. & N. He later served as a carpenter and a bridge foreman and in 1895, he was promoted to acting supervisor of bridges and buildings on the Atlanta division. In 1905, he was advanced to system bridge erector, and in 1914, he was appointed supervisor of bridges and buildings of the Louisville division, with headquarters at Louisville, which position he held until his retirement.

Carl S. Heritage, bridge engineer of the Kansas City Southern, with headquarters at Kansas City, Mo., and president of the American Railway Bridge and Building Association from 1930 to 1934, died in that

Carl S. Heritage

city on August 31. Mr. Heritage was born at Pennsville, N. J., on September 3, 1880, and graduated in civil engineering from Lehigh University in 1904. He entered railway service in 1903, during his summer vacation as an assistant on the engineering corps of the Baltimore & Ohio at Chicago, and in 1904, after graduation, went with the erection department of the Pennsylvania Steel Company, Steelton, Pa., later serving as a draftsman for McClintic-Marshall Company, Pittsburgh, Pa., and Waddell & Harrington, consulting engineers, at Kansas City. In 1910, he returned to railway service as a bridge draftsman for the Kansas City Southern at Kansas City and in 1915, he was promoted to bridge engineer, the position he held until his death.

C. S. Gzowski, chief engineer of construction of the Canadian National, with headquarters at Montreal, Que., died in that city on September 7 after a short illness, at the age of 64. Mr. Gzowski was born on May 1, 1876, at Toronto, Ont., and was educated at Bishop Ridley's College and the School of Practical Science of the University of Toronto. During the summers of 1895, 1896 and 1897 he worked in the engineering departments of various railroads and from 1897 to 1905 was engaged in railway location and construction for the Canadian Pacific and other roads in Ontario and the western provinces. From 1905 to 1906 he was a partner of Loss & MacDonnell, builders of the Nicola Kamloops and Similkameem branch of the Canadian Pacific from Spence's Bridge, B. C. In 1906 he formed a partnership under the name of Macdonnell, Gzowski & Co., Vancouver, B. C., in charge of a considerable mileage of railway construction in British Columbia, Montana, Idaho and Washington; among these, the spiral tunnels of the Canadian Pacific at Field, B. C. He was also engaged in municipal improvement work. In 1914 the partnership was dissolved and Mr. Gzowski engaged in private engineering practice until 1916, when he was appointed valuating engineer for the Royal Commission of Enquiry into Railways and Transportation. In April, 1917, he again entered private practice and on December 1, 1917, he was engaged by the directors of the Canadian Northern to assist in the arbitration of the value of their stock. From January, 1918, to April, 1919, he engaged in special work for the vice-president of the Canadian Northern and on the latter date became special engineer to the vice-president of operation, maintenance and construction, Canadian National. From October, 1920, to March, 1923, he served as assistant to vice-president, construction, same road, and became chief engineer of construction in March, 1923.

Robert Faries, assistant chief engineer of the Pennsylvania in charge of maintenance of roadway and track, with headquarters at Philadelphia, Pa., died of a heart attack on September 8, at his home in St. Davids, Pa. Mr. Faries was born at Bellwood, Pa., on November 30, 1881, and entered railroad service with the Pennsylvania on the Pittsburgh division on May 5, 1899, as a laborer in the maintenance of way department at Gallitzin, Pa. Within a few months he was promoted to rodman, and after several years' experience in that capacity he was placed in charge of the engineering work involved in the construction of the terminal yard and facilities at Pittsburgh. After serving as transitman and assistant supervisor on various divisions, Mr. Faries was appointed supervisor of track on August 1, 1905, serving in this capacity at Jamesburg, N.J., Trenton, Washington, D.C., and Baltimore. From June 1, 1917, to February 1, 1918, Mr. Faries served as division engineer successively at Elmira, N.Y., Williamsport, Pa., and Pittsburgh. On November 1, 1924, he was transferred to the operating department as superintendent at Buffalo, N.Y. In 1928, he was promoted to assistant chief engineer-maintenance, with headquarters at Phila-

Robert Faries

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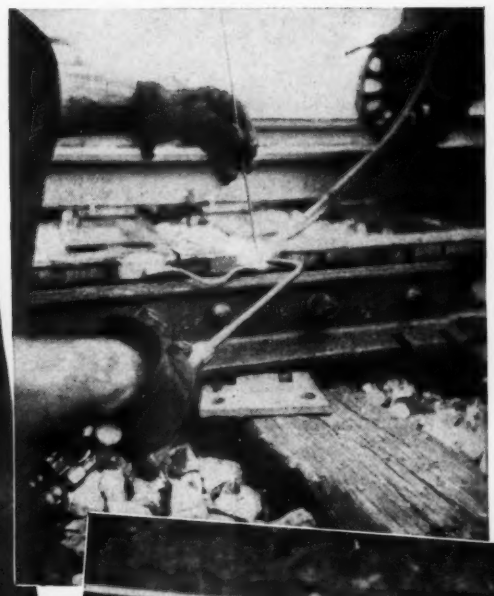

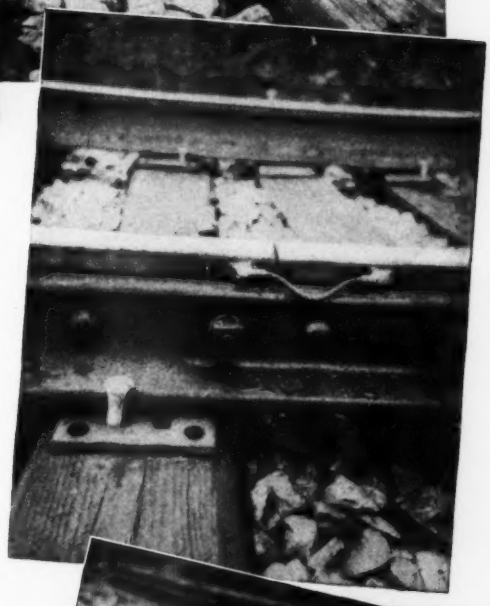

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delphia. For many years Mr. Faries had been active in the affairs of the American Railway Engineering Association. At the time of his death he was serving as a member of the Board of Direction and as vice-chairman of the Committee on Rail. Also, he had recently been appointed chairman of the Committee on the Relations of Track and Equipment of the Association of American Railroads.

Leonor F. Loree, an engineer by training and experience and widely known as one of the country's most able railroad executives, who retired as president of the Delaware & Hudson on March 31, 1938, died at his home in West Orange, N. J., on September 6, at the age of 82, after an illness of several years duration. Mr. Loree was born in Fulton City, Ill., and was educated in civil engineering at Rutgers university. He entered railroad service in 1877 as an assistant on the engineer corps of the Pennsylvania, and later

Leonor F. Loree

served two years as a transitman with the engineer corps, U. S. Army, and for several years with the Mexican National Railway in various capacities on surveys. In 1883, he returned to the Pennsylvania as an assistant engineer, being promoted to engineer maintenance of way in 1884, in which capacity he served on various divisions. In 1889, he was transferred to the operating department as division superintendent of the Cleveland & Pittsburgh division and in 1896, at the age of 38, he was appointed general manager of the Pennsylvania, becoming fourth vice-president in 1901. Shortly thereafter Mr. Loree became president of the Baltimore & Ohio, leaving this post four years later to become president of the Chicago, Rock Island & Pacific and chairman of the Executive committee of that company and of the St. Louis-San Francisco. After nine months in these capacities he became chairman of the Executive committee of the Kansas City Southern, which position he held until 1937. He served as president of the Delaware & Hudson from 1907 to April, 1938. At various times he also served as chairman of the board of the Missouri-Kansas-Texas and as a director of various railroads. He was president of the American Railway Association between 1899 and 1901, and in 1913 served as chairman, Eastern group, Presidents' Conference Committee on Valuation.

Association News

American Railway Engineering Association

Late in the month, the secretary's office will mail to the members of the association the September-October Bulletin, No. 419, which will be issued in two parts. Part I will include the reports of the Electrical section, Engineering division, A.A.R., to be presented at the meeting of that section to be held at the Hotel Sherman on October 29; a report of the Joint Committee on Specifications for Concrete and Reinforced Concrete; and a special report of the Committee on Economics of Railway Labor, consisting of a digest of the testimony on the mechanization of operations in the maintenance of way department, presented by a special committee of the A.A.R. before the Wage and Hour division of the Department of Labor last spring. Part II of the bulletin will include 26 additional trackwork plans, prepared by the Committee on Track, to be submitted for adoption at the convention of the association in 1941.

Six committees held meetings during September, five in Chicago, concurrent with the Roadmasters' convention to afford members an opportunity to attend sessions of the convention and to visit the exhibit of the Track Supply Association held in conjunction therewith. The committees which met include the following: Uniform General Contract Forms, at New York, on September 9; Roadway and Ballast, at Chicago, on September 9-10; Maintenance of Way Work, Equipment, at Chicago, September 9-10; Rail, at Chicago, September 11; Track, at Chicago, September 12; and Special Committee Stresses in Railroad Track, at Chicago, September 12.

Eight other committees plan meetings during October, as follows: Waterways and Harbors, at Chicago, on October 1; Yards and Terminals, at Buffalo, N. Y., on October 7-8; Highways, at Chicago, on October 10; Wood Bridges and Trestles, at Chicago, on October 17; Co-operative Relations with Universities, at Ann Arbor, Mich., on October 21; Water Service, Fire Protection and Sanitation, at Chicago, October 24; Economics of Railway Labor, at Chicago, October 25; and Iron and Steel Structures, at Urbana, Ill., October 10-11.

Bridge and Building Association

The program for the 47th annual convention which will be held at the Hotel Stevens, Chicago, on October 15-17, has now been completed and indicates one of the most practical conventions in the history of the association. Likewise, all but one of the committee reports are now completed and in the hands of the secretary. The program is as follows:

Tuesday, October 15

Morning Session—10:00 a.m.

Convention called to order.

Opening address by C. E. Johnston, chairman, Western Association of Railway Executives, Chicago.

Greetings from the American Railway Engineering Association, G. S. Fanning (chief engineer, Erie, Cleveland, Ohio), President.

Greetings from the Roadmasters and Maintenance of Way Association, J. J. Clutz (division engineer, Pennsylvania, Indianapolis, Ind.), President

Greetings from the Bridge and Building Supply Men's Association, H. A. Wolfe (railroad representative, Lehon Co., Chicago), President.

Address by President A. E. Bechtelheimer (assistant engineer bridges, C. & N. W., Chicago).

Report of Committee on The Mechanization of Bridge and Building Forces; M. H. Dick, Chairman (eastern editor, *Railway Engineering and Maintenance*, New York).

Afternoon Session—2:00 p.m.

Report of Committee on The Detection and Elimination of Termites in Railway Structures; T. H. Strate, Chairman (division engineer, C. M. St. P. & P., Chicago).

Address on Streamlining the Smaller Passenger Stations, by Otto Kuhler, consulting designer, New York.

Report of Committee on The Inspection of Buildings to Formulate the Maintenance Program; L. E. Peyser, Chairman (assistant architect, S. P., San Francisco, Cal.).

Adjourn at 4:00 P.M. to visit exhibit of Bridge and Building Supply Men's Association.

Tuesday Evening—8:00 p.m.

Address on The Bridges on the Shasta Line Diversion of the Southern Pacific Company, by George W. Rear (bridge engr., Southern Pacific, Pacific System).

Wednesday, October 16

Morning Session—9:30 a.m.

Report of Committee on Protecting Steel Structures from Severe Corrosion; A. M. Knowles, Chairman (assistant engineer structures, Erie, Cleveland, Ohio).

Address on How Bridge and Building Officers Can Co-Operate with the Purchasing and Stores Department in Protecting Their Material Requirements, by Roy D. Long, general purchasing agent, C. B. & Q., Chicago.

Report of Committee on The Repair and Renewal of Ballast Deck Bridges; W. A. Sweet, Chairman (general foreman bridges and buildings, A. T. & S. F., Newton, Kan.).

Luncheon—12:15 p.m.

Address on Current Railway Problems.

Afternoon Session—2:00 p.m.

Report of Committee on The Adjustment of Locomotive Watering Facilities to Larger Tenders and High-Speed Trains; W. G. Powrie, Chairman (engineer water service, C. M. St. P. & P., Chicago).

Report of Committee on The Heating of Locomotive Terminal and Shop Buildings; I. A. Moore, Chairman (supervisor bridges and buildings, C. & E. I., Danville, Ill.).

In Memoriam, Calvin A. Lichty; Past-President Elmer T. Howson presiding—Brief addresses by Past-Presidents C. R. Knowles, J. P. Wood and Armstrong

Continued on page 690

COMPRESSORS
for YOUR MAINTENANCE of WAY NEEDS . . . . . .

9 SIZES AND A MOUNTING TO FIT YOUR NEEDS

Gasoline or Diesel engine drive. Electric starting, of course. Tell us your air needs we'll show you the compressor.

FOR 4 TAMPERS

(Above) **OFF- AND ON-TRACK**—Easily moved off or on the track—easily moved along the shoulders or on the rails—a complete gasoline engine driven compressor with cooling unit, air receiver and pressure control. Electric starting, of course.

(Left) **ON-TRACK, SELF-PROPELLED** Carries men, tools and equipment to the job—easily derailed—a low priced, gasoline engine driven compressor for the smaller job.

FOR 24 TAMPERS

OFF-TRACK, SELF-PROPELLED—Made narrow enough to travel on the shoulders, or between the rails. Each track independently, mechanically driven forward and reverse. Climbs 45° and turns completely around on its own center. Keeps cool in 120° ambient.

ON-TRACK, SELF-PROPELLED—Mechanical propulsion, forward and reverse, speeds to 40 m.p.h., brakes on 2 or 4 wheels. Quick mechanically operated transverse wheels for derailing. Tool boxes and other accessories as you may desire.

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ESTABLISHED 1900

WEST CHESTER PENNA., U. S. A.

Chinn and by Tom Lehon, past president, Bridge and Building Supply Men's Association.

Wednesday Evening

Annual dinner jointly with the Bridge and Building Supply Men's Association.

Thursday, October 17

Morning Session—9:30 a.m.

Report of Committee on The Storage and Delivery of Bridge and Building Materials; R. E. Caudle, Chairman (assistant engineer structures, M. P., Houston, Tex.).

Closing business.

On Thursday afternoon the members will visit the system storehouse of the Chicago, Burlington & Quincy at Aurora, Ill., where opportunity will be afforded to study the manner in which bridge and building materials are assembled, stored and distributed.

Metropolitan Maintenance of Way Club

The first meeting of the club will be held on October 24, at the Governor Clinton hotel in New York. Following dinner, which will be served at 6:30, the meeting will be addressed by J. M. Fox, division engineer on the Pennsylvania at Jersey City, N. J., who will discuss the practice of providing deep side ditches as a means of draining the roadbed. Deep ditching has been employed extensively on the important New York-Philadelphia line of the Pennsylvania with a high degree of success, and Mr. Fox will describe the methods used and the results obtained. The program of the meeting will also include several additional features of special interest.

Bridge and Building Supply Men's Association

Twenty-two companies have already arranged to participate in the exhibit to be presented coincident with the convention of the American Railway Bridge and Building Association at the Hotel Stevens, Chicago, on October 15-17, with other applications coming in daily. Further applications should be addressed to W. B. Carlisle, secretary, Bridge and Building Supply Men's Association, care of the National Lead Company, 900 W. 18th Street, Chicago. The companies that have arranged to participate in the exhibit to date include the following:

Air Reduction Sales Company, New York
American Lumber & Treating Company, Chicago
Armco Railroad Sales Company, Middletown, Ohio
Buda Company, Harvey, Ill.
Celotex Corporation, Chicago
Dearborn Chemical Company, Chicago
Dickinson, Paul, Inc., Chicago
Joseph Dixon Crucible Company, Jersey City, N. J.
Duff-Norton Manufacturing Company, Pittsburgh, Pa.
Homelite Corporation, Worcester, N. Y.
Johns-Manville Sales Corporation, New York
Lehon Company, Chicago
Mall Tool Company, Chicago
Massey Concrete Products Corp., Chicago
Master Builders Company, Cleveland, Ohio
National Lead Company, New York
Patterson Sargent Company, Cleveland, Ohio
Pocket List of Railroad Officials, New York
Railway Engineering and Maintenance, Chicago
Ruberoid Company, Chicago
Timber Engineering Corporation, Washington, D. C.
United States Wind Engine and Pump Company, Batavia, Ill.

Supply Trade News

Personal

P. J. Christy has been appointed manager of the Philadelphia (Pa.) office of the **Chicago Pneumatic Tool Company,** effective August 1, succeeding **A. M. Brown,** who has been transferred to Washington, D. C., as manager of a new branch opened in that city recently. **C. A. Diehl** has been appointed manager of the Houston, (Tex.) office.

John E. Stapleton, assistant to the vice-president in charge of sales of the **Carnegie-Illinois Steel Corporation,** has been appointed assistant manager of sales for the New York district. Mr. Stapleton attended the University of Cincinnati (Ohio) and entered service with the Carnegie Steel Company in 1917. From 1921 to 1926 he served as a salesman in the Kentucky coal fields, and for the next

John E. Stapleton

eight years was resident salesman at Columbus, Ohio. He was resident salesman at Youngstown, Ohio, from 1934 to 1936, when he was appointed assistant to the manager of sales, with headquarters at Chicago. In February, 1938, he became assistant to the Carnegie-Illinois vice-president in charge of sales.

Obituary

C. M. Hoffman, who retired as vice-president of the Dearborn Chemical Company, Chicago, in 1936, died in Los Angeles, Cal., on September 9. He was born in Moncton, New Brunswick, on July 29, 1870, and entered railway service as an apprentice on the Chicago, Burlington & Quincy at St. Joseph, Mo. After serving as a machinist and foreman he was promoted to road foreman, from which position he resigned to become master mechanic of the Southern at Princeton, Ind. After holding this position for five years he became superintendent of motive power for the St. Louis, Brownsville & Mexico at Kingsville, Tex., and five years later became master mechanic for the United Verde Mines at Clarkdale, Ariz. Later he served as master mechanic for the Denver & Rio Grande Western at Grand Junction, Colo., master mechanic for the Utah Copper Company and superintendent of motive power for the Los Angeles & Salt Lake. In 1924, he resigned from the latter position to enter the employ of the Dearborn Chemical Company as assistant to the vice-president. In 1928 he was promoted to vice-president in charge of railway sales, the position he was holding at the time of his retirement in 1936.

C. M. Hoffman

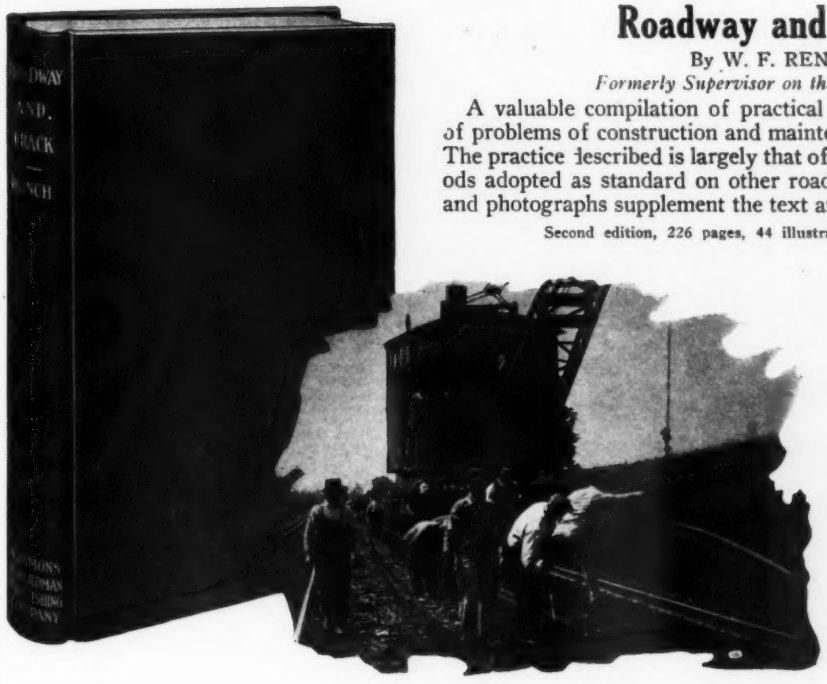
Trade Publications

Motorpump—The Ingersoll-Rand Company, New York, has issued an illustrated folder showing details of this company's Motorpump.

Quality of Pressure Treatment—The Wood Preserving Corporation, Pittsburgh, Pa., has published a piece of literature entitled, How to Measure the Quality of Pressure Treatment You Buy, which presents the standards for penetration and determination of penetration in Southern yellow pine piles, poles and lumber and in Douglas fir piles and lumber.

Insulation and Building Products—The Philip Carey Company, Cincinnati, Ohio, has published a 12-page booklet describing briefly the various types of heat insulation and building materials manufactured by this company, including heat insulation materials for temperatures ranging from sub-zero to 2500 deg. F. Other materials described include air-conditioning equipment, corrugated roofing and siding, roof coatings, floorings, insulation materials for walls and roofs and numerous building accessories. The booklet is profusely illustrated with photographs showing the use or installation of Carey products.

Practical Books That Will Help Maintenance Men Do Better Work



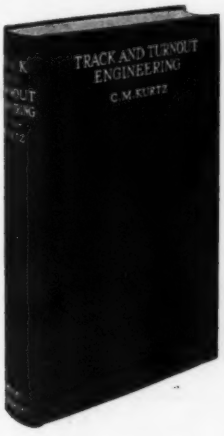
Roadway and Track

By W. F. RENCH

Formerly Supervisor on the Pennsylvania

A valuable compilation of practical information on the solution of problems of construction and maintenance of roadbed and track. The practice described is largely that of the *Pennsylvania*, but methods adopted as standard on other roads are also given. Drawings and photographs supplement the text and there is a complete index.

Second edition, 226 pages, 44 illustrations, cloth, 6x9, $2.00



Track and Turnout Engineering

By C. M. KURTZ

Engineer, Southern Pacific Company

This handbook for location, construction and maintenance of way engineers, transitmen and draftsmen, gives practical mathematical treatment of track layout and other problems. These are **fully exemplified** and worked out in detail, and illustrated with drawings of accepted designs for fixtures and track layouts. It contains original as well as a complete set of standard railway engineering handbook tables. All computing problems which may arise in track engineering are thoroughly treated by an engineer of 25 years' experience. 457 pages, 116 illustrations, 33 tables, flexible binding, 5x7 inches, $5.00.

Practical Trackwork

By W. F. RENCH

A handbook giving expert information on the design, fabrication and installation of standard trackwork. Thoroughly describes switch stands, switches, frogs, crossings and slip switches. 256 pages, 110 illustrations, tables, index, flexible binding, 5x7, $1.50.

Simplified Curve and Switch Work

By W. F. RENCH

This little book has practically revolutionized curve and switch calculation practice since its appearance 15 years ago. The proved accuracy of its methods has caused them to be adopted as standard practice on many roads.

Complex algebraic and geometric calculations are reduced to their simplest form and as nearly as possible to terms of simple arithmetic. Application of these calculations to the actual job is made plain by brief explanations. Drawings further clarify the subject and make the meaning of the text unmistakable. Short cut formulae are featured. String lining and tape line layouts are fully explained. 212 pages, 24 illustrations, 5x7, cloth, $2.00.

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( ) Simplified Curve and Switch Work, $2 ( ) Practical Trackwork, $1.50

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Summer
Straight Wing Spreading
Flanging Ballast

Fall
Widens Banks
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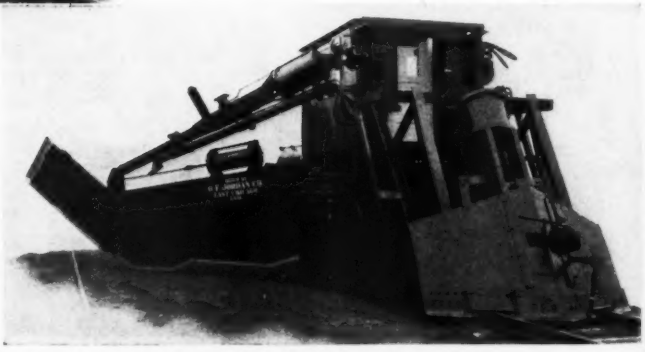

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FOR SAFE WIRE ROPE FASTENING

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Does your locomotive crane show as an asset on your books when, in reality, it stands in the way of much lower handling costs? Industrial Brownhoist Diesel crane operating costs are available for practically all classes of service. If the above figures do not apply to yours, we will be glad to furnish those which do. Just write or call our nearest office.

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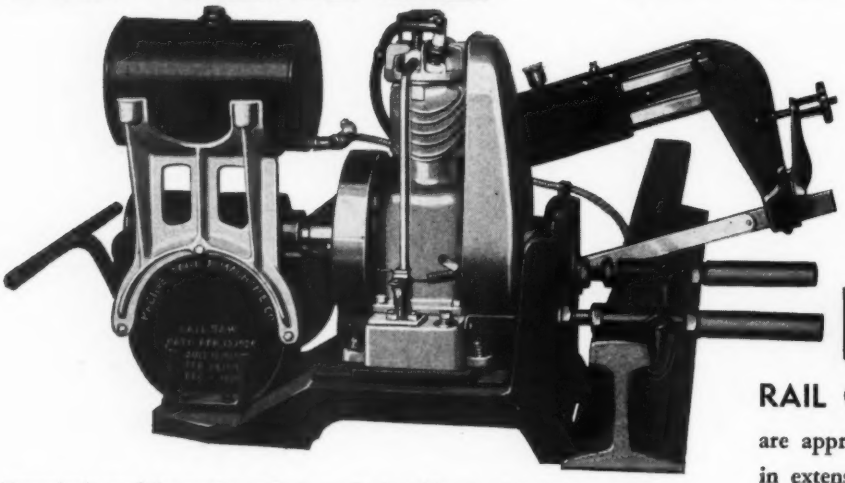
RACINE Cuts Rails *Safer at Lower Costs*



Extensively used for cutting rails in track; installing insulated joints; fitting up switches, frogs, and crossings; end cropping operations and for reconditioning old rails in storage yards. Make straight cuts exactly where required. No burning or shattering of grain structure in rails.

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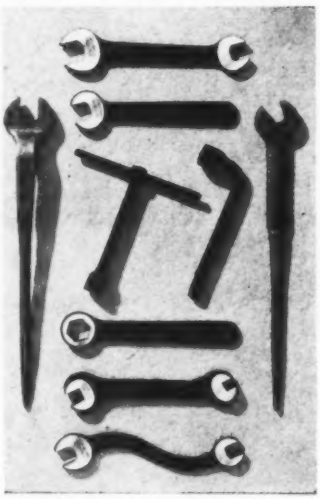

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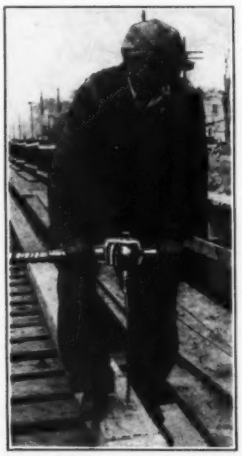

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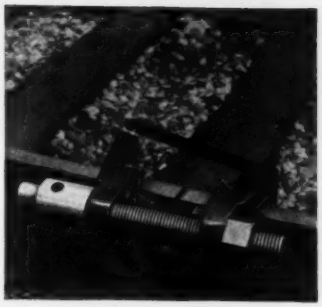

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—long and favorably known to railroad men *is still available*—

Manufactured by the Asphalt Process Corporation under A P K O T E Brand.

Sold to railroads exclusively under COLLINS brand

Specify "COLLINS" *for Grade Crossings and Station Platforms*

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Please send me complete RUGGEDWEAR information . . . details of FREE TRIAL OFFER. No obligation.

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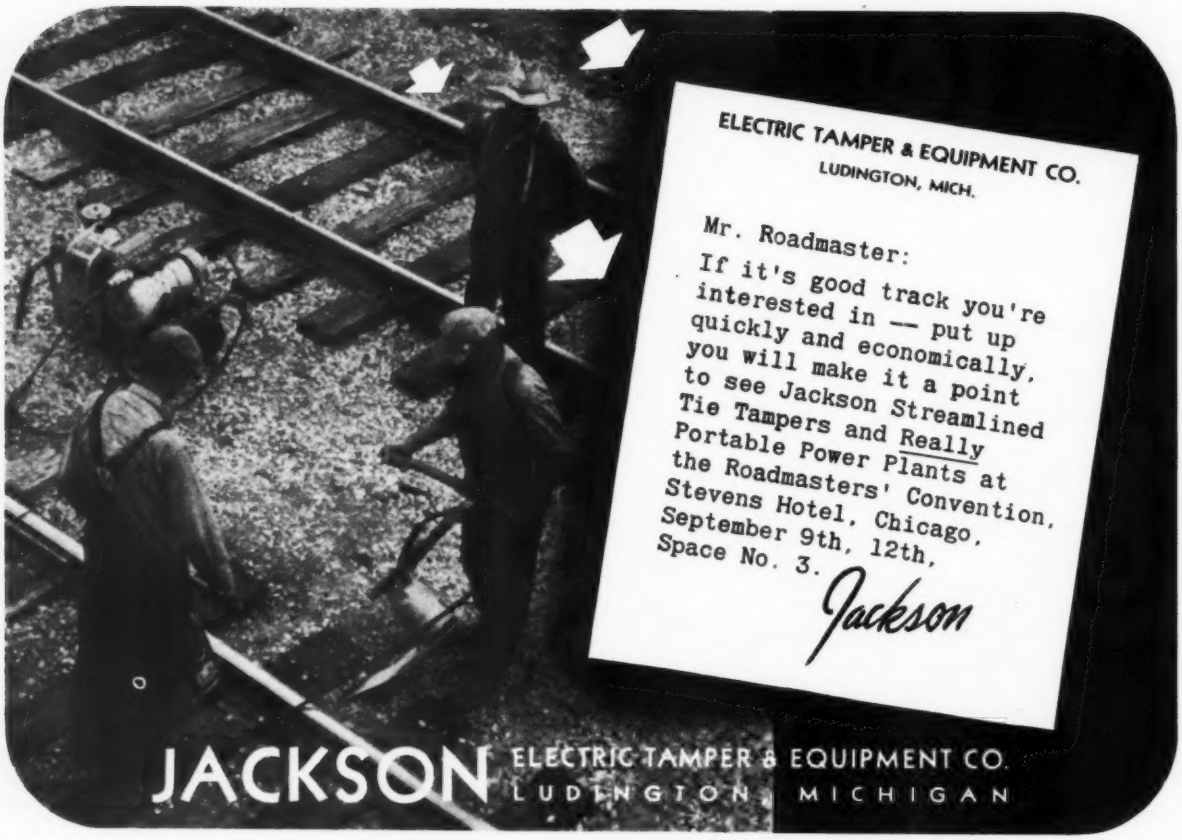
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If it's good track you're interested in — put up quickly and economically, you will make it a point to see Jackson Streamlined Tie Tampers and Really Portable Power Plants at the Roadmasters' Convention, Stevens Hotel, Chicago, September 9th, 12th, Space No. 3.
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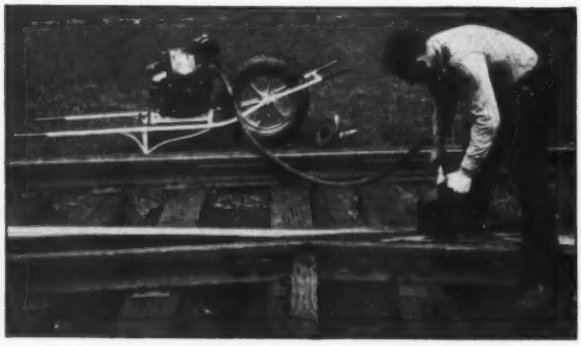
Preparedness to handle any traffic volume with utmost speed and safety will be expected of America's railroads. Only on well-maintained track can such service be performed dependably. Railway Track-work Rail Grinders are able and ready to do their part for you with utmost economy. A wide choice of models enables you to choose designs that meet your requirements accurately. Write for latest data bulletins.

TRACK SUPPLY ASSOCIATION SEPT. 9-12, 1940 EXHIBITOR ROADMASTERS CONVENTION

Space 80-81



Model P-22—one of many models.

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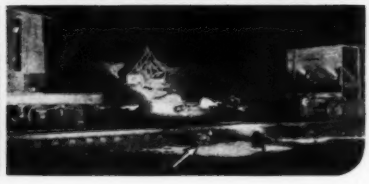
WORLD'S HEADQUARTERS FOR TRACK GRINDERS

742

I've been working on the Railroad All The Live-Long Day

Operating Electric Tools By Day

Operating Flood Lights By Night



There's one thing you can say about a Homelite Portable Generator—it's never out of work; never idle. You can use it at night to operate floodlights—illumination that saves time, steps, money, and prevents accidents. Or you can use it during the day to give your track crews power for operating cost-cutting electric tools.
Light and portable—only 82 pounds complete with built-in gasoline engine—one of these 1800 watt output units can be easily transported anywhere. You're always sure of an electricity supply. And due to the Homelite's superior construction—you're always sure of satisfactory results. Hundreds of these units are now working on the railroad—saving money all the live-long day. Write for bulletin.

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American Equipment Corp. 629
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See Pittsburgh Screw and Bolt Corporation.

American Hoist & Derrick Co. 693
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Carnegie-Illinois Steel Corporation 620
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Chicago Pneumatic Tool Company 626
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Lufkin Rule Co., The 697
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Lundie Engineering Corporation, The 613
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Milwaukee, Wisconsin.
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Oxweld Railroad Service Company, The 610-611
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Railway Maintenance Corporation 634
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Reliance Spring Washer Division 602
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See Eaton Manufacturing Company.

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Tar and Chemical Division 607
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See Koppers Company.

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Jacks, Track; Rail Puller & Expanders, Tie Spacers.

Tennessee Coal, Iron & Railroad Company 620
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See U. S. Steel Corporation Subsidiaries.

Timken Roller Bearing Company, The 628
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Union Carbide and Carbon Corporation 610-611
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See Oxweld Railroad Service Co.

U. S. Steel Corporation Subsidiaries 620
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Warren Tool Corporation 631
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Williams & Co., J. H. 696
225 Lafayette St., New York City.
Drop-Forged Wrenches (Carbon and Alloy), Detachable Socket Wrenches, Reversible Ratchet Wrenches, Tool Holders, "C" Clamps, Lathe Dogs, Eye Bolts, Hoist Hooks, Thumb Nuts and Screws, Chain Pipe Tongs and Vises, etc.

Wood Preserving Corporation, The 608
Pittsburgh, Pennsylvania.
See Koppers Company.

Woodings Forge & Tool Co. 619
Verona, Pennsylvania.
See Woodings-Verona Tool Works.

Woodings-Verona Tool Works 619
Verona, Pennsylvania.
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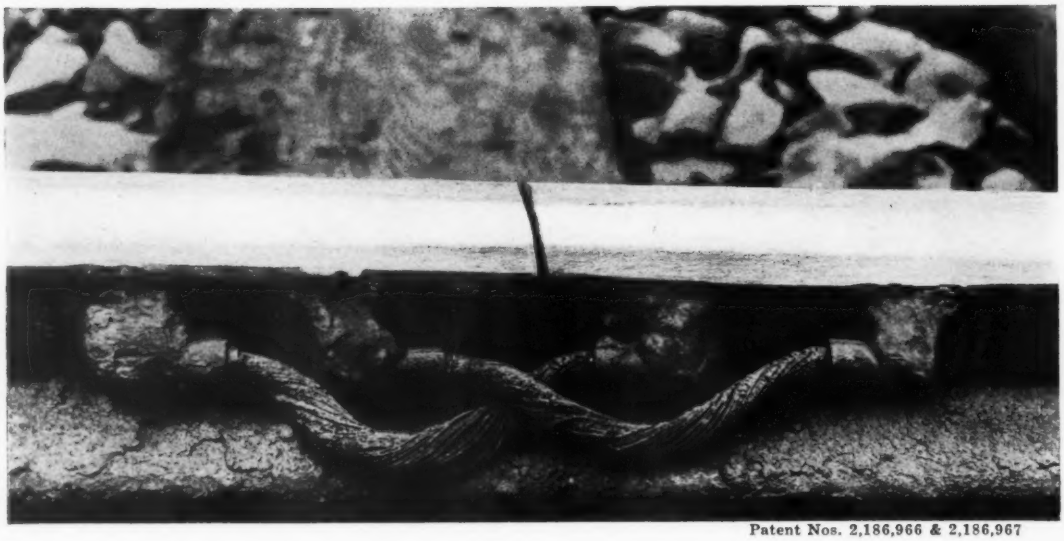
IMPROVED HIPOWER

... improved Track

HE NATIONAL LOCK WASHER COMPANY

NEWARK, N. J., U. S. A.

THE RAILS CO.



Patent Nos. 2,186,966 & 2,186,967

STRIP WELDING

A Lower Cost Method for Building Up Battered Rail Ends

Strip welding is a simplified procedure, a tried and proven invention, which for the first time permits and assures accurate control of the hardness and other physical properties uniformly throughout the entire weld, and without the necessity of a separate heat treatment. NO SPECIAL EQUIPMENT OR MATERIALS ARE NEEDED.

The hardness recommended in order to insure a permanently smooth riding surface is in the range of 350-400 Brinell, and is uniformly obtained by reason of the metallurgical principles upon which Strip Welding is based. Because of the fact that, possessing this hardness, the riding strip in the central zone or crown of the rail is permanently resistant to batter and chipping, it is readily seen that it is unnecessary to build up any more of the battered zone than this central riding strip, one to one and one-half inches wide. However, simply neglecting to build up all of the width of the battered area, by procedures which do not control the hardness is false economy, because such welds will batter too rapidly. The durability of rail ends repaired by Strip Welding has been demonstrated by long service under heavy and fast traffic.

The quantities of welding gases and rod metal are LESS THAN HALF the amounts formerly required, per linear inch of the built up zone. The same is true OF DIRECT WELDING LABOR. However, the chief advantage is the ability to repair and maintain in smooth riding condition about double the track mileage formerly possible, for a given expenditure of money and time.